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METALS & ALLOYS

The Magazine of Metallurgical Engineering

PRODUCTION · FABRICATION · TREATMENT · APPLICATION

Current Metallurgical Abstracts

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METALS & ALLOYS

The Magazine of Metallurgical Engineering

Production • Fabrication • Treatment • Application

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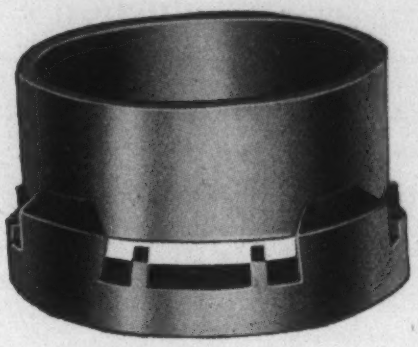

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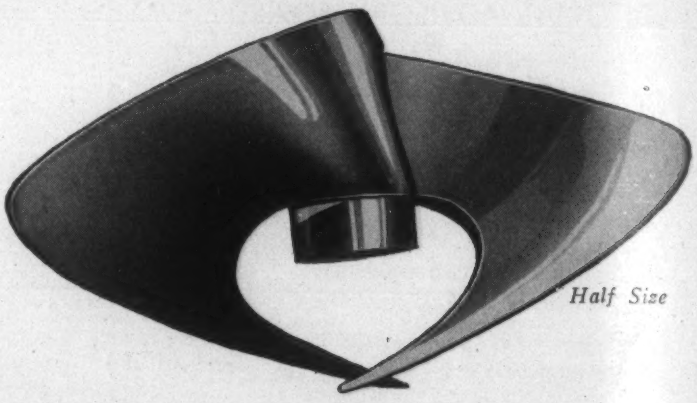

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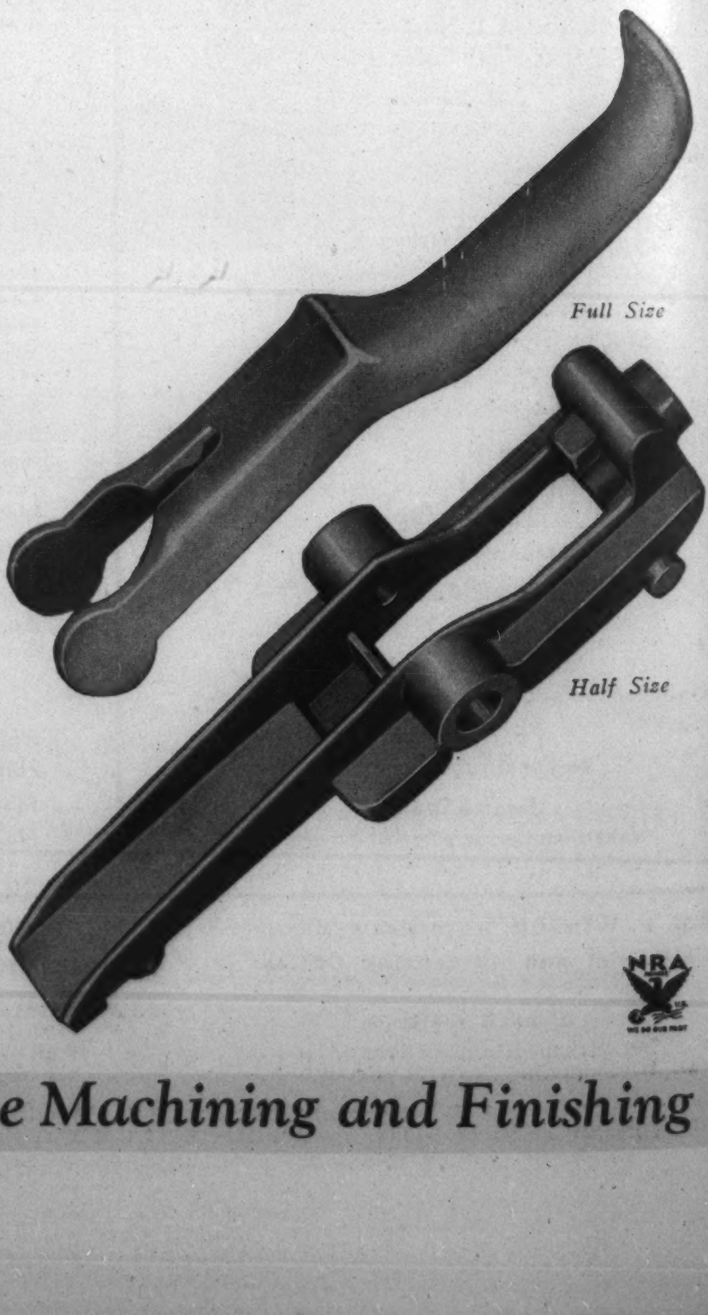

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Strength in Parts that Require Little Machining and Finishing

HIGHLIGHTS

by H. W. GILLETT

DO YOU want to know what metallurgical engineers are saying, the world over? Look in the Current Metallurgical Abstracts. Here are some of the points covered by authors whose articles are abstracted in this issue.

Charge Manganese Ore

The German Steel Works Committee (page MA 176 R 1) finds it cheaper to charge manganese ore to the basic open hearth and melt the charge down over 1% in carbon in order to reduce the ore to metallic manganese, than to use high manganese pig. Benedicks & Löfquist (page MA 177 L 2) advocate adding manganese oxide to the slag when ferromanganese is added to the bath, during the finishing of the heat.

"Pumping"

A Committee of the Belgian Foundry Assn. (page MA 176 R 2) discusses how to aid the feeding of a casting by "pumping" the feeding head with a rod.

Sponge Iron in Open Hearth Charge

According to Grannikov (page MA 177 L 1) German experience with sponge iron in a steel charge, indicated that it can satisfactorily make up only 10% of the charge.

No Final Deoxidizers?

Schönburg (page MA 175 L 1) alleges that German open hearth practice is trending toward use of high residual manganese and avoiding (Minimizing?) the use of final deoxiderizers, such as ferromanganese, ferrosilicon and aluminum, but the *Iron & Steel Industry* (page MA 175 L 2) states that British practice does not favor high residual manganese.

German High Strength Steels

According to Gerritsen & Schoenmaker (page MA 197 R 1) the high strength German structural steels of the Cu-Mn type, with or without Cr or Mo are especially suitable for welding, failure never occurring in the zone between weld and parent metal.

Cupola Design

Itam (page MA 176 R 4) thinks that smaller tuyeres would make a better cupola, while Steyer (page MA 191 L 1) reports that cupolas are made of so many shapes and dimensions and varying tuyere design that most of them must be wrong and concludes that nobody knows much about cupola design anyhow.

Annealing Fine Wires

The *Deutsche Goldschmiedezeitung* (page MA 185 L 1) states that fine wires can be bright annealed by pulling them through a tube filled with steel tacks and heated at the center. To keep the tacks in place, two wires are pulled through simultaneously, one in each direction.

Gas Carburizing

Spicer (page MA 187 L 6) claims that gas carburizing with butane is so clean that the outfit can be put anywhere in the production line.

Cast Iron

von Schwarz (page MA 215 L 1) has published an article of 164 pages on the structure and properties of cast iron.

Cleaning Blast Furnace Gas

Richarms (page MA 188 L 1) devotes 50 pages to a review of the methods of cleaning blast furnace gases by electrostatic precipitation that are in use all over the world.

Weld Shape

Thum (page MA 210 R 1) calls attention to the shape of a weld (Freedom from notches and irregularities) and argues that this may be far more important under repeated stress than the actual soundness of the weld.

High Melting Point

Claasen & Burgers (page MA 214 L 1) report a compound ZrW_2 that has a melting point of 2200°C.

Cold Working

Thomassen & McCutcheon (page MA 183 L 1) show how the depth to which metal is cold worked in machinery can be revealed by X-ray methods and hence the effects of different variables in the machining process on the degree of cold working they produce, may be evaluated.

Precipitation Hardening

Precipitation hardening again crops up, Dahl & Pfaffenberger (page MA 221 R 3) suspecting it in Permalloy and Köster (page MA 221 R 8) utilizing it in special alloys for magnets that are free from the cracking and other troubles connected with heat-treatment of ordinary magnet steels.

Carburizer for Steel and Cast Iron

Petroleum coke is the most active carburizer to add to a melt of steel or cast iron, say Nipper & Piwowarsky (page MA 175 L 3).

Overnight Endurance Method

The applicability of a short-cut, so called "overnight method" of determining endurance limits suggested last summer by Prof. H. F. Moore is now said by Prof. Moore (page MA 210 R 3) to be somewhat doubtful for some nonferrous metals.

The Dirty Spoon

It doesn't matter if the egg isn't all washed off the spoon, for Raub (page MA 237 L 1) says "no bacteria can develop in the food particles on silver."

Abrasion and Corrosion

According to Keene & McFarland (page MA 236 R 1) combined abrasive action of coal and corrosion of mine water, in anthracite-breaker chutes may best be combated by an alloy containing 20% Cr and 1% Cu.

Resistor Alloy

Grunert (page MA 228 R 1) and coworkers advocate a 30% Cr, 5% Al, 65% Fe alloy for electrical resistor elements instead of NiCr, claiming twice the life for it.

Gold Plating Steel

Gold plating of steel, over a layer of nickel, would form a good coating for protection against corrosion, say Leonhardt & Steel (page MA 228 R 3) because it adheres well, has about the same coefficient of expansion and doesn't set up a high electromotive force.

Quenching and Internal Stress

It is possible to obtain a quenched steel free from internal stress, say Buehler and Scheil (page MA 221 R 2).

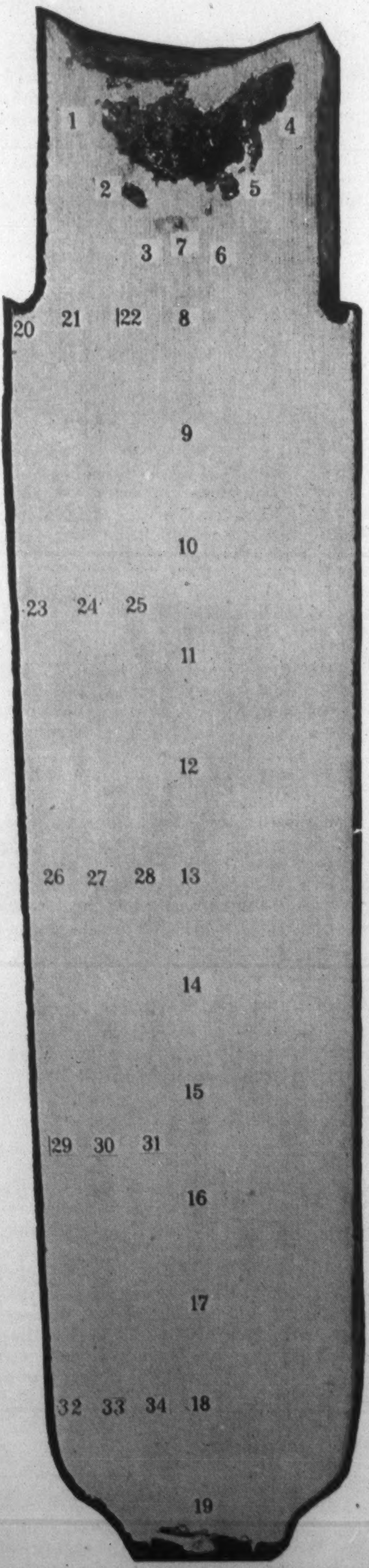
Plating

Claymann (page MA 204 L 3) says that a Ni coat over which Cr is to be plated, ought to be polished to overcome passivity of Ni and make it take a good Cr coat, so that there is no use depositing bright Ni. Korpiun and Vogel (page MA 204 L 1) however, say that bright Ni should be deposited because the throwing power of Cr is better than over dull Ni that has been polished, and cite figures showing 100% difference in throwing power between dull Ni that has been polished, and a very bright deposit.

Superheating Malleable

According to Schneidewind and White (page MA 187 L 1) superheating of malleable iron in melting, e.g. in an electric furnace, makes it possible to reduce the time of the malleablizing anneal materially.

Uniformity and Soundness in Ingots



Courtesy of PITTSBURGH STEEL CO.

A SOUND INGOT is at the same time the only safe foundation for a reliable product and the best assurance of low final production costs.

The ingot pictured is a 19 x 22 x 74″ selected at random from a .14 carbon heat for seamless tubing and is typical of the soundness and homogenity obtainable by any steel producer with Gathmann big-end-up molding methods.

Segregation Analysis

No.	Carbon	Manganese	Sulphur	Silicon
1	.12	.53	.023	.085
2	.12	.53	.022	
3	.17	.57	.027	
4	.11	.53	.020	
5	.11	.55	.021	
6	.16	.56	.026	
7	.215	.58	.034	
8	.16	.56	.027	
9	.16	.57	.024	
10	.14	.56	.024	
11	.14	.55	.023	
12	.14	.55	.024	
13	.13	.55	.022	
14	.13	.54	.022	
15	.12	.54	.023	
16	.12	.53	.021	
17	.11	.54	.023	
18	.11	.55	.022	
19	.13	.54	.024	
20	.14	.56	.024	
21	.15	.55	.025	.10
22	.16	.55	.026	
23	.13	.56	.026	
24	.14	.55	.025	
25	.16	.56	.026	
26	.14	.55	.025	
27	.14	.57	.025	.09
28	.14	.56	.025	
29	.13	.54	.024	
30	.14	.56	.024	
31	.14	.54	.023	
32	.13	.54	.025	
33	.13	.56	.023	.09
34	.13	.55	.023	
Ladle	.14	.54	.025	.09

THE GATHMANN ENGINEERING COMPANY

DESIGNERS OF INGOT MOLDS
SINCE 1909

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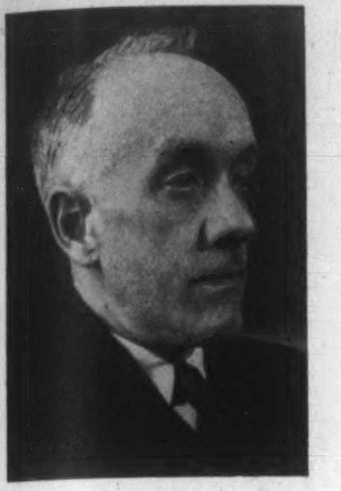
MARYLAND



EDITORIAL COMMENT

Behind the Scenes

OUR BRITISH contemporary, *The Metallurgist,* in its March 1934 issue, discusses editorially a subject that concerns both editors and readers. This is that *not all that is published is correct,* so that an uncritical reader may easily be misled, especially when he happens to read material on only one side of a controversial matter.

This is certainly true in politics and economics, though few readers fail to realize that there is more than one point of view in those fields, even though they may intentionally take care to read only those publications that agree with their own feelings. But in fields of science and technology, such as metallurgical engineering, where facts rather than feelings rule, the tendency to believe what one reads is probably less modified by knowledge that there may be other equally tenable points of view.

As *The Metallurgist* points out, the danger is perhaps greater when alleged information is taken from abstracts rather than from original articles, because the abstractor must present the author's conclusions and does not have space to reproduce the data and the conditions under which those data were obtained, from which the expert might appraise the probable value of the conclusions. To correct this tendency, perhaps the most useful effort, continues *The Metallurgist,* is the critical compilation of all the information available on a given topic, as is done in its own columns, and in the "correlated abstracts" in Metals & Alloys (for the bouquet, many thanks). But till more technical journals do that sort of thing, much published information that is wrong, doubtful, or misleading, may remain without corrective comment. How can the publication of misleading information or half-baked conclusions be minimized?

It is pointed out that papers presented before technical societies must be open to discussion and that published discussion, and the author's reply, will serve as a corrective or clarify the situation better than the paper itself did. It is argued that to "referee" articles for publication in the technical press is difficult because if there is disagreement with the results or doubt as to their reliability, rejection of the article "suppresses" the work. Yet since much useful material falls outside the scope of the technical societies, and since the crowding of a session with too many papers prevents time for the discussion that may be needed to clarify them, the societies cannot take care of all technical publications, so that there is a wide field for the technical press not directly connected with any society.

Our own attempt at a solution of this problem is never to rely exclusively on our own judgment in acceptance or rejection. We may take the reader behind the scenes in the progress of an article toward publication. Even though we may have suggested that our readers would be interested in an article on a given subject by a given author, that does not commit us to printing it, as is, when it is received. Each article, solicited or unsolicited, is read and then referred to at least one other reader picked for his knowledge of the field in which the article lies, often indeed, to several such readers. Naturally the coöperation of our Editorial Advisory Board is widely utilized in this way, but many other experts are similarly called upon for help, which is almost without exception ungrudgingly and usually most gladly given, for such leaders in metallurgy seem to feel it a duty and a privilege to help safeguard the accuracy and completeness of published metallurgical information.

Then the collected comments, suggestions and queries of the Editorial staff and the other readers are passed on the author, anonymously and in impersonal fashion. We find that authors as a class are not so touchy and filled with pride of authorship that they refuse to profit by the suggestions. Instead, they gladly consider them, clarify points that were obscure and often carry out extensive additional experiments to answer pertinent points that are raised. Often a slight change of phraseology will correct a statement that failed to tell what the writer really meant. Thus the final revised article has incorporated within it the useful aspects of technical society discussion, without wasting space on the platitudes that occur in many such discussions. When an article is published it also has these corrections and amplifications incorporated in their logical positions in the original, and they are not missed by the reader, as is so often the case when the reader studies a preprint, but does not attend the technical society session or read the published discussion in the society's transactions which generally appear many months after the preprint does. An erroneous impression may be corrected by discussion, but it is not erased unless the discussion is read, so there is much in favor of incorporation of comment into the body of the revised article.

Of course it may happen that in order to give suitable credit to someone who has supplied particularly helpful comment, it is not feasible to incorporate that comment, but better to append it, publishing it with the article, in the same issue, so it will not be missed by the reader.

Then, too, readers who wish to add comment to, or to take issue with an article after it is published, are free to send in their comment as a "letter to the editor" for subsequent publication. The Editorial staff and the authors welcome such comment, and we again invite it. The readers thus have it in their own hands to aid the publication of information that is as reliable as the combined knowledge of both author and readers can make it in the present state of knowledge.

Incidentally, the editorials may or may not be read by others than the editorial staff before publication, but editorials are supposed to represent opinion, based on what the editors consider facts. They are in a different category from a feature article or a correlated abstract. There is no implied obligation that anyone should agree with an editorial!—H. W. GILLETT

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Action of Fluorspar

on Open Hearth Basic Slags

A Correlated Abstract by Lenher Schwerin

(Continued from April issue)

Part II. Desulphurization and Dephosphorization

BEFORE discussing the part that fluorspar plays in desulphurization and dephosphorization, it seems desirable to consider in a general way the conditions which accompany and favor these processes in the basic open-hearth furnace.

Sulphur has sufficient affinity for oxygen at relatively low temperatures that the sulphides of iron and manganese may be oxidized by ferric oxide from the iron ore or scale, forming lower oxides of these metals and gaseous SO_2, which escapes. Low carbon heats are tapped at about 1600° C. or a little higher, although heats in which the carbon is caught on the way down may be tapped about 100° lower. At these higher temperatures the relative affinities of sulphur for oxygen and for iron have changed so much that very little SO_2 will form, particularly as it can be reduced by carbon monoxide. Morover, most of the ferric oxide will have been reduced to FeO, which is a much weaker oxidizing agent.

The reaction by which the slag takes up sulphur from the metal is chiefly as follows:

$$FeS + CaO + CO = Fe + CaS + CO_2.$$

The partition of sulphur between metal and slag is determined partly by the relative solubilities of the sulphides concerned. Iron sulphide is soluble in the metal bath and but sparingly in the slag, while manganese sulphide is slightly soluble in both, and calcium sulphide is soluble in the slag but not in the metal. The above reaction involving the formation of CaS is favored by a large proportion of lime in the slag, strong reducing conditions and high temperature. Therefore the removal of sulphur from the metal in this manner might be expected to proceed to a greater extent in the blast-furnace, cupola and electric furnace than in the open-hearth, where the atmosphere is oxidizing rather than reducing. To make the above equation applicable to electric furnace practice it may be rewritten substituting for CO some other reducing agent such as C, CaC_2 or Si. Another similar equation showing the formation of CaS by the use of fluorspar is given by Sisco[6] and by Camp and Francis[24] as follows:

$$2CaF_2 + 2FeS + Si = 2CaS + SiF_4 + 2\ Fe.$$

Desulphurization can not be effected in this manner in the electric furnace until the metal and slag have been deoxidized.

Courtesy Bethlehem Steel Company

Manganese, under the conditions obtaining in basic open-hearth operations, has a greater affinity for sulphur than has iron. Therefore, the amount of manganese ordinarily contained in the charge as compared with the sulphur present is great enough so that all the sulphur may be considered as existing as manganese sulphide. The equations written above may be revised to conform with this consideration.

Phosphorus occurs in the metal as the compound iron phosphide, Fe_3P, and is removed by oxidation to P_2O_5, which is acid like silica. When formed, it must be neutralized by combining with a base. Camp and Francis[24] represent the above by the equation

$$2Fe_3P + 8FeO = (FeO)_3 \cdot P_2O_5 + 11Fe.$$

They state that silica will replace P_2O_5 in the ferrous phosphate, exposing the phosphorus pentoxide to reduction so that phosphorus is not permanently removed from the metal until the silicon has been practically eliminated. In the basic process the abundance of lime in the slag is more than sufficient to neutralize the silica, so that the ferrous phosphate not only forms but is converted in the slag into the more stable calcium phosphate, $(CaO)_3 \cdot P_2O_5$. This is easily reduced, however, and will remain in the slag only if the latter is maintained strongly basic and moderately oxidizing.

Calcium phosphate, $Ca_3\ (PO_4)_2$, and calcium fluoride form a eutectic melting at 1205° C., containing about 65% CaF_2. Magnesium phosphate, $Mg_3(PO_4)_2$, and magnesium fluoride, MgF_2, unite in equimolecular proportions to form a compound melting at 1253° C. Two eutectics are also formed, one melting at 1076° containing 2.8% MgF_2 and the other melting at 1105° containing about 61.3% MgF_2.[36]

Early in the basic open-hearth heat, during the "ore boil," while the temperature is low, some of the sulphur will be oxidized and carried off with the products of combustion. Phosphorus, silicon and manganese will be oxidized at this time, the phosphorus entering the slag as described above. Later, when the carbon is being removed, the temperature is increasing, which is necessary to keep the bath molten. Phosphorus is more likely to be reduced from the slag at high temperatures than oxidized

Courtesy Youngstown Sheet & Tube Company

from the metal. Also, the oxidation of silicon in the iron decreases the basicity of the slag, thereby hindering desulphurization. It is therefore not unusual to work with two separate slags. The first slag takes up much of the silica and phosphorus and is run off.

During the "lime boil" the lime replaces the iron oxide in the phosphates and silicates, becoming part of the slag and increasing its basicity. Thus, the slag is in condition to take up sulphur from the bath and retain the phosphates and silicates together.

Later, during the "working period," the slag must be highly oxidizing to remove the carbon from the metal and retain the phosphorus. Camp and Francis[24] say, "But even with the chemical composition of the slag properly adjusted, its activity will depend upon the fluidity to a great extent. The reagents at the disposal of the operator for regulating these properties are iron oxide, limestone, dolomite and fluorspar."

One of the most recent contributions to the question of desulphurization is a valuable paper by Bettendorf and Wark.[39] By way of introduction they say, "There are two principal views concerning the improved action of desulphurization by the addition of fluorspar. According to one conception—the work of A. N. Diehl,[40] C. H. Herty, Jr.,[41] C. H. Herty and M. Gaines,[42] A. C. Dalton,[43] F. T. Sisco[44] and B. Neumann[45] should be referred to—the addition of fluorspar makes the lime very fluid and hence also more reactive toward the sulphur; according to the other view the desulphurizing action with the addition of fluorspar is traceable to the formation of a gaseous sulphur fluoride. . . . This manner of desulphurization, which is considered especially in the work of S. Schleicher,[5] H. Ulitzsch,[46] E. Wilke-Dörfut and H. Buchholz[47] and R. B. Ladoo,[3] is perhaps the most effective, since it removes the sulphur as a gas from the iron as well as the slag, whereby the resulphurization from the slag is prevented and the slag is able to take up additional sulphur."

Until recently the first of these has been commonly recognized as the more important of the two. Thus, Colclough[48] says, "The function of the spar (in the basic open-hearth) is primarily to act as a fluxing agent so that the slag may carry a high CaO content. In addition, there is evidence that, when fluorspar is present, the phosphate formed in the slag may have the composition $CaF_2 \cdot 3CaO \cdot P_2O_5$, i.e., a fluor-apatite, instead of $4CaO \cdot P_2O_5$.

"Thus fluorspar acts in a double capacity. By its fluxing power it enables more lime to be carried at a given temperature and, in addition, it reduces the amount of lime required to combine with the phosphoric oxide present. Both actions tend to give to the slag a higher capacity for carrying phosphorus." As Colclough sees it, manganese is the desulphurizing agent, lime and fluorspar merely aiding the following reactions:

$$Mn + FeS = MnS + Fe$$
$$2MnS + 3O_2 = 2MnO + 2SO_2.$$

The first takes place in the metal, the MnS formed rising to the slag, where the second reaction takes place. A high lime content in the slag tends to decrease the amount of FeO, which he says, has a vital influence on the process of desulphurization. When the FeO in the slag is high, "there can be no reduction of the MnO, and therefore no increase of manganese in the metal. . . . The manganese in the metal falls and desulphurization practically ceases. It seems probable that MnS reacts with FeO in the mass of metal as by the equation:

$$MnS + FeO = FeS + MnO,$$

and the FeS formed remains in solution in the steel. . . . Therefore, the real effect of a spar and/or high lime slag is equivalent to the addition of manganese to the metal."

A similar view is held by Goldmann,[20] who, speaking of his experience at the Falva works, has suggested using fluorspar in open-hearth furnace practice to decrease the consumption of ferromanganese by conserving the manganese in the pig iron used. The function of the fluorspar is to increase the fluidity so that a greater depth of slag can be used. This is intended to protect the original manganese in the charge. These conditions are also favorable for the removal of phosphorus and sulphur. Killing,[49] however, reports no success in attempting to carry out Goldmann's suggestion.

Referring to cupola practice, Osann[7] says, "Desulphurization has never been claimed by use of fluorspar per se, but results from thinning down of the slag so that its lime can be brought into more intimate contact with the metal. High manganese in the charge also favors desulphurization by the formation of MnS, which with other sulphur compounds will trend upward more rapidly with a fluid slag, and either unite with it or form a layer between metal and slag, as in lead refining. The presence of iron oxide in cupola slag obstructs the formation of CaS, which is borne out by the fact that in the electric furnace, desulphurization can only be carried through successfully with white slags, which are free from iron oxide." In this connection it should be pointed out that in the presence of considerable amounts of iron oxides in the basic open-hearth furnace, the removal of sulphur from steel has been successfully accomplished by means of fluorspar additions. The mechanism, however, did not merely involve slagging off the sulphur, but removing it by volatilization also. This will be discussed later.

Osann[50] investigated the question of desulphurization in the basic electric furnace. At first he tried to remove the sulphur by an extremely basic slag, thinned with fluorspar; but this was not successful to the extent required, and he found that to reduce the sulphur to 0.01% or less it was necessary to add some powerful reducing agent to remove the oxides in the slag. Carbon was not found to be efficient and 50% ferro-silicon was finally decided upon. Since the conditions are so highly reducing, the desulphurization by this method is carried out after the removal of phosphorus, the slag containing the phosphorus being poured off as completely as possible and a new slag made with lime and fluorspar. Otherwise the phosphorus would be reduced. The presence of iron oxide in the slag prevents desulphurization because of the strongly exothermic reaction

$$FeO + CaS = FeS + CaO,$$

which would put the sulphur back in the metal. It would be difficult to apply this method of desulphurization in the open-hearth as worked under ordinary conditions with a high phosphorus iron, but it is quite suitable for the electric furnace. Comparing the conditions under which phosphorus and sulphur are transferred from metal to slag, it is to be noticed particularly that the former is favored by oxidation and the latter by reduction. Both processes require high basicity of the slag, which must be kept fluid.

Some years ago Keeney[51] made some experiments on the use of fluorspar in electric smelting of iron ore directly into steel. "The work was performed in a furnace lined with magnesite, having 2 upper vertical electrodes of graphite connected in parallel and a conducting hearth of iron rods imbedded in magnesite, the hearth and the graphite electrodes being connected in series." The charge consisted of hematite, coke, limestone and fluorspar, and in 5 different heats only the ratio of fluorspar to limestone was changed. A table shows that as the ratio was increased, the carbon content of the metal increased from 0.44 to 2.25%. While the products of lower carbon content may properly be referred to as steel, the metal with the highest carbon is, strictly speaking, pig iron.

Keeney says, "The most marked result of the increased fluorspar charged in proportion to the lime is in the increase of carbon in the pig steel with each increase of fluorspar.

"The increase of carbon in the pig steel may be explained in 2 possible ways. The excessive thinning of the slag may have resulted in coke coming in close contact with the steel, thus carbonizing it. Or, there may not have been any tendency to the formation of calcium carbide with the smaller percentage of lime in the charge, and the quicker fusion resulting from a more easily fused charge.

"In the opinion of the writer the elimination of silicon, phosphorus and sulphur from the metal, is due largely to the thinning effect of the fluorspar upon the slag which permits intimate contact and washing of the metal by the slag. Silicon, phosphorus and sulphur in this way have a greater opportunity of combining with lime to form silicates, phosphates or phosphides, and sulphates or sulphides. Either of the latter might form owing to the weakly reducing atmosphere of the furnace. The value of a very thin slag for the removal of phosphorus in the reduction of iron ores and in the manufacture of ferro-alloys has been evident throughout the experiments I have made."

Bettendorf and Wark,[39] previously referred to, have carried out some experiments in both laboratory and commercial size furnaces which confirm the foregoing and give additional information. They find that between the limits of 1300° and 1600°C. an increase in temperature favors desulphurization, which confirms general experience in practice. Experiments with slags composed of lime and fluorspar only, show that the addition of fluorspar to the lime acts favorably on desulphurization until an optimum value is reached, which lies at about 50% CaO and 50% CaF_2. They conclude that lime is the principal agent of desulphurization. However, with lime-silica slags they conclude that the desulphurizing effect of fluorspar which is added, next to the production of a reactive lime depends upon the volatilization of sulphur from the slag. By decreasing the sulphur content of the slag the latter can take up additional amounts of sulphur from the metal bath. By prolonging the reaction time not nearly so complete desulphurization can be obtained as by increasing the quantity of the slag. Stronger bases such as strontianite, soda and potash give the best desulphurization. By such additions in a basic open-hearth slag the removal of sulphur in the steel was increased about 40%. They also found that desulphurization was improved by adding reducing agents, such as carbon and silicon, which destroyed the oxides in the slag. With increasing quantities of manganese in the charge, they observed a uniform decrease of sulphur in the steel and an increasing sulphur content in the slag. An explanation for this is offered by the fact that with higher manganese in the steel and also in the slag, a greater part of the sulphur in the slag remains combined, while with lower manganese it is volatilized on account of the fluorspar in the slag. Promoting desulphurization by higher manganese can therefore be explained with Schenck[52] by the manganese opposing the formation of ferrous oxide in the slag. The synthetic slag used in these experiments contained no ferrous oxide, however, so that they did not expect desulphurization to be dependent upon increasing manganese. They assume that with high manganese contents in the bath desulphurization by liquation of manganese sulphide can take place.

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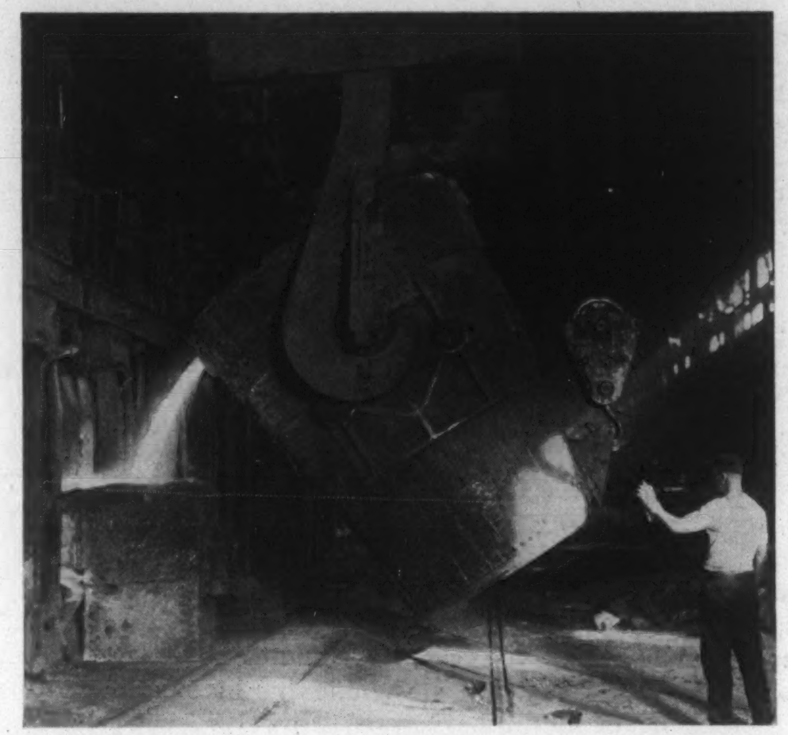

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Sillars[53] credits Saniter with being the first one to introduce fluorspar into steel metallurgy to remove sulphur. According to Harbord and Hall,[54] the Saniter process is a method of desulphurization based on the use of calcium chloride and lime, with or without fluorspar. The process may be carried out in 2 ways—1. by treating molten cast iron in a ladle as it comes from the blast furnace; 2. by desulphurizing the molten metal during its conversion into steel in the basic open-hearth furnace or basic Bessemer converter. They say that it seems probable that an oxychloride of lime of indefinite composition is formed, which enables a slag of great fluidity and high basicity to come in contact with the metal. According to Geiger,[9] "Saniter found years ago that spar added to the charge during the melting-down period had a tendency to eliminate a part of the sulphur as a volatile fluorine-sulphur compound." More recently, however, Saniter's belief as to why fluorspar is used to remove sulphur in basic open-hearth processes seems to ignore volatilization, when he says,[53] "I am afraid I can not (give a chemical formula for that) but the practical matter about it is this, that the addition of fluorspar to the slag in the basic open-hearth furnace allows you to use a slag of sufficient liquidity much richer in lime than can be used without the presence of fluorspar, and it is necessary in order to get successful desulphurization to have from 50 to 53% of lime in the slag of the basic open-hearth process, and by that means the richer lime slag, presumably, has a considerably stronger affinity for the sulphur than the iron has."

It remained for Schleicher[5] to prove that fluorspar also partakes in the more effective process of desulphurization by volatilization, more effective because there is not merely a partition of the sulphur between the metal bath and the slag, but some of the sulphur leaves the entire system. His experiments were conducted on actual commercial heats in basic open-hearth furnaces.

He defines the partition coefficient of sulphur as the ratio of sulphur in the slag to sulphur in the metal. A table is given showing the sulphur content of metal and slag from 9 basic open-hearth heats without the addition of fluorspar. The average partition coefficient for sulphur is found to be 3.15. A second table shows the corresponding values for 9 heats of 30 tons each to which, besides equal quantities of lime, 400 kg. of fluorspar were added. In this case the partition coefficient of sulphur was increased to 6.5 on the average. The metal retained in the first 9 heats an average of 0.08% S, while in the latter 9 heats the sulphur was reduced to an average of 0.05%. Schleicher says, "It can happen in steel making that one at times must work with a very low manganese charge which contains so much sulphur that it is out of the question to work it without fluorspar if one is to meet the prescribed limit of 0.06%. From such heats these 9 were chosen." In the discussion on this paper he says, "The 9 heats with fluorspar and 9 without, mentioned at the beginning of my paper, came from similar manganese-poor and sulphur-rich heats to which neither spiegel-eisen nor high manganese pig iron had been added. The desulphurization is thus not the result of the influence of manganese but of calcium fluoride."

"It had previously been assumed that the desulphurization by fluorspar was due to the slag being rendered more basic by the addition of fluorspar and yet the necessary degree of fluidity being retained to give a good reaction. The following experiments will show, however, that the desulphurization can not be explained in this manner." Two finished slags, one without fluorspar treatment and the other with, showed that the basicity (ratio of oxygen in the bases to oxygen in the acids) of the former was 1.67 and of the latter 1.30, and yet the sulphur partition coefficient in the first case was 3.50 and in the latter 7.3. "The reason for the increase in the partition coefficient can not lie in the degree of basicity." Schleicher found this to be borne out by numerous other cases.

A typical sulphur balance showed in the case of one heat the following figures: "The weight of the steel was 55,000 kg., that of the slag before the fluorspar addition, 7,900 kg., that of the final slag 9,000 kg. Before the fluorspar addition there were in the steel 0.081% = 44.55 kg. and in the slag 0.36% = 28.44 kg., a total of 72.99 kg. of sulphur, but in the finished products, in the steel 0.06% = 33.0 kg. and in the slag 0.24% = 21.6 kg., a total of 54.60 kg. of sulphur present, so that 18.39 kg. of sulphur are lacking."

In order to prove the volatilization of sulphur, some furnace gas was led through KOH solution, and allowing for the amount of sulphurous acid which would come from the burning of the producer gas, it was found that the sulphur did not escape from the slag as sulphurous acid. The possibility of the formation of sulphur fluoride was suggested. The tube through which the gas had been led in the experiment above was water cooled, and it was thought that possibly the sulphur-fluorine compound might have condensed in the tube because of its low temperature, so that a hot porcelain tube was used to conduct the gas through the KOH in another experiment. By this means it was established that the sulphur had been volatilized by the influence of the fluorspar, but it was not determined what sulphur-fluorine compound was formed.

Samples of metal and slag from many heats taken before and from time to time after the addition of fluorspar showed that the immediate effect of the fluorspar addition was to remove considerable amounts of sulphur from the metal-slag system. Under certain conditions resulphurization of the metal, in spite of fluorspar additions, may take place with very rapid elimination of carbon, and also with soft heats when the fluorspar is added suddenly in large amounts to the finished slag. But always in these cases a decrease of sulphur content of the slag was so marked, that the sum of the sulphur in the bath and in the slag had decreased considerably. Within a short time the slag would again take up sulphur from the bath and because of the removal of sulphur from the whole system the sulphur content of the metal was decreased considerably.

In the discussion on this paper, St. Kritz[5] of Düsseldorf says, "According to our experiments the work of the writer (Schleicher) concerning the beneficial influence of fluorspar additions is confirmed."

Glaser[55] has reviewed recent work on slags, and concerning Schleicher's investigation concludes that the effect of fluorspar is based upon the production of a very fluid, reactive slag. Concerning desulphurization in the basic electric furnace by means of fluorspar, he states that the sulphur content of the metal bath is not a function of the partition coefficient, and suggests that the explanation may be the higher temperature of the electric furnace causing the slag to be more reactive than that of the open-hearth.

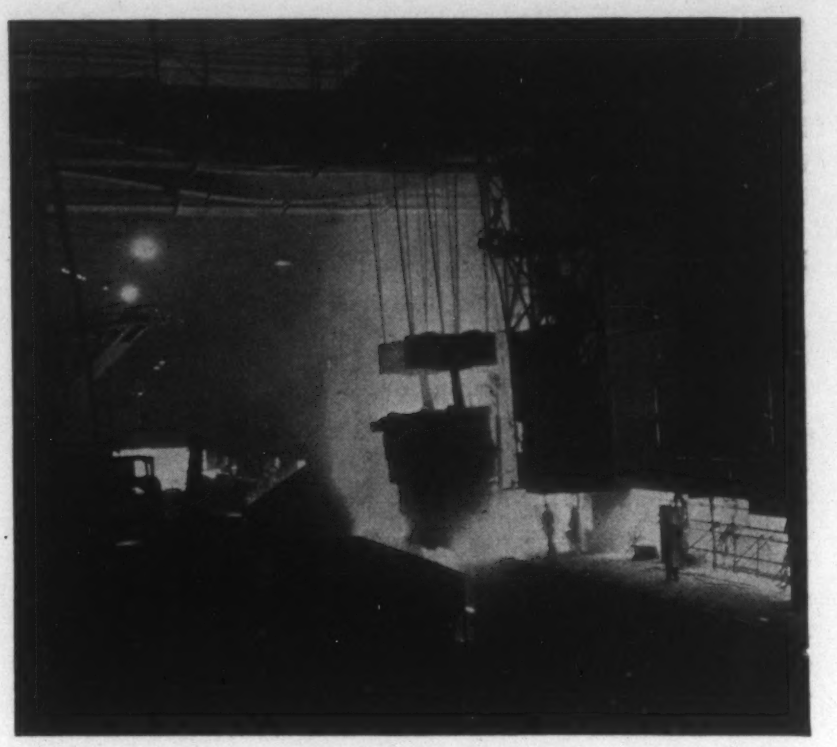
A more recent paper by Schleicher[56] presents additional data showing that the influence of fluorspar, outside of the greater fluidity and reactivity of the slag, depends upon a volatilization of fluorine-sulphur compounds out of the slag, which takes up more sulphur from the bath.

Wilke-Dörfut and Buchholz[47] investigated the effect of various fluorides as desulphurizers on cast iron. Experiments were made in crucibles containing molten iron, slag and the fluoride desulphurizing agent. The sulphur content of the iron was lowered and the results showed that the process does not merely involve migration of sulphur from the metal to the slag, but a removal from the whole system by the formation of a volatile fluorine compound.

Long before these experiments immediately above were performed, Goldmerstein[57] proposed to introduce manganic and ferric fluorides into the metal bath in the open-hearth, the fluorides being contained in iron cartridges. He stated that fluorine, having a greater affinity for the impurities, phosphorus and sulphur, than for iron, will form volatile compounds with them, which would thus be eliminated. He also proposed to eliminate sulphur and phosphorus from pig iron in the Bessemer process by converting them into volatile fluorides, introducing the necessary fluorine as manganese sesquifluoride, Mn_2F_6. It may be introduced with the blast after silicon has been burned out, as otherwise the fluorine would be lost by combining with silicon. Calcium fluoride was not to be used, because he considered it too stable, as it is not decomposed at steel-making temperatures; also AlF_3 and MgF_2 are not decomposed but go into the slag. He observed that fluorine has particular affinity for those elements of atomic weight near its own and forms stable compounds with them.

Referring to the Saniter process, Harbord and Hall[54] say, "One curious effect of the calcium chloride and fluorspar appears to be that they considerably reduce the solubility in citric acid of the phosphoric acid in the slag, an important point, as the value of the slag as a fertilizer depends largely upon this solubility." This effect has been shown by Burman,[58] who added varying quantities of fluorspar to slags containing phosphoric acid and determined the solubility of the latter with and without fluorspar. Such behavior has been a key to the determination of the manner in which the fluorspar is combined with phosphorus in basic slags.

Gilchrist and Louis[59] say that according to Stead, calcium phosphate is but slowly attacked by citric acid and the silico-phosphate is readily attacked. The former would result from the basic open-hearth process, the latter from the basic Bessemer, because "pig iron suitable for the basic Bessemer must be relatively high in silicon and its treatment in the converter produces silico-phosphates, whereas for the basic open-hearth process, pig iron is required to be as low as possible in silicon, so that practically the whole of the phosphorus is converted into calcium phosphate."



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It was found that the phosphate is completely soluble in citric acid if sufficient time is spent on the extraction and if a sufficient excess of citric acid is used. (The more highly basic slag would naturally neutralize more acid due to its lime content.)

Bainbridge[60] writes, "No matter what form of compound the phosphoric acid assumes in a basic open-hearth slag the addition of calcium fluoride to the molten mass appears to bring about the formation of a compound consisting of approximately 8 parts of CaF_2 united with 100 parts of tribasic phosphate of lime, which agrees closely with the formula for apatite, $3(3CaO \cdot P_2O_5) \cdot CaF_2$, wherein 100 parts $3CaO \cdot P_2O_5$ unite with 8.37 parts CaF_2.

"On the addition of CaF_2 to a fusion of tetrabasic phosphate free lime is liberated, and in the case of silico-phosphate dicalcic silicate is liberated." He also concludes that when a sufficient quantity of CaF_2 is added to a molten basic slag the whole of the phosphate is converted into apatite. Without fluorspar the phosphoric acid forms silico-phosphate of lime, $3CaO \cdot P_2O_5 : 2CaO \cdot SiO_2$ or a similar silico-phosphate such as Steadite, $3(CaO \cdot P_2O_5) : 2CaO : 2CaO \cdot SiO_2$, both of which are extremely soluble in citric acid. When the P_2O_5 is approximately 14% in normally produced basic slag, free lime does not exist to any extent. Considering this extremely high phosphorus content, the reader should realize that English practice is referred to.

Bainbridge and Stead[61] present additional evidence that fluorapatite is formed when fluorspar is added to basic slags. They also assume that since calcium chloride has an effect similar to that of fluorspar, chlorapatite is formed.

Tests by some of these writers and by Robertson[62] show that solubility by the citric acid test is no criterion of the fertilizing value of basic open-hearth slags.

Since the foregoing was written, Matsukawa[63] has published in Japanese the results of some important work on the viscosity of acid and basic open hearth slags. The paper is not yet available in English, but Matsukawa, summarizing the results in a private communication to the writer, says, "Different views have been held as to the action of fluorspar in the open-hearth slag. The present author ascertained the relation between the viscosity of molten slag and the amount of fluorine in it. 0.1 to 0.4% F was found in 10 basic open hearth slags. The amount of spar added to the slag is 0.3 to 5% of the latter and 15 to 16% CaF_2 of the spar is present in the slags. Spar makes the viscosity of basic open hearth slag low and melting temperature remarkably low. 1% F lowers the melting temperature about 100°C. Examining the analytical results of slags to which spar was added, the losses of F and Si correspond to the ratio SiF_4."

Losana[64] has also measured the viscosities of some open hearth furnace slags and evaluated the effect of adding varying amounts of fluorspar. He found that additions of up to 5% decreased the viscosity, but that at 10% the viscosity again increased, except when high silica was present. He concludes that there is an optimum amount of fluorspar to add, which increases with the silica content of the slag.

It seems extraordinary that the viscosity should again increase with additions of 10% fluorspar, an observation which has apparently not hitherto been made. Perhaps a significant fact in this connection is that Losana's viscometer made use of a graphite rod rotating in the molten slag contained in a graphite crucible. It is the present writer's experience concerning the measurement of slag viscosities that when slags containing the reducible oxides of iron and manganese are in contact with graphite at steel-making temperatures, these oxides are very quickly reduced.

Matsukawa,[63] referred to above, used in his viscometer a rotating cylinder covered with platinum and a platinum crucible, thus avoiding the danger of change of composition by reduction during the viscosity determinations.

Summary

1. It is recognized that fluorspar is extremely effective in reducing the viscosity of basic slags. However, it remains to be shown why small amounts of this flux exert such a powerful influence.

2. Fluorspar is of great assistance in removing impurities from steel by basic processes. By increasing the fluidity of the slag and thereby increasing its activity it speeds up the reactions taking place; it also permits very basic slags to be employed, which would otherwise be too viscous to be worked. Thus, it favors the removal of sulphur and phosphorus from the metal into the slag. It is also directly effective in removing sulphur by combining with it, forming a volatile sulphur-fluorine compound which passes out of the furnace.

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Convention of American Electro-Platers' Society

The convention of the society will be held in Detroit, June 11-14, 1934. The program of the educational sessions follows:

Monday, June 11

Summary of Researches on Plating at the Bureau of Standards. Dr. W. Blum, Bureau of Standards, Washington, D. C.
Complete Report of Exposure Tests on Plated Steel with Recommendations. P. W. C. Strausser (Research Associate for the A. E. S.) and Dr. W. Blum.
Plans for Investigating the Plating of Non-Ferrous Metals. Dr. W. Blum.
Testing of Plated Metals for Compliance with Federal Specifications. M. R. Thompson, Bureau of Standards.
Formal Discussion of Thompson's Paper by Wm. M. Phillips, General Motors Corp., Detroit, Chairman, Joint Committee on Specifications for Plating.

Tuesday, June 12

Nickel Plating. Ray Goodsell, Racine Plating Works, Racine, Wis.
Bright Nickel Plating. L. E. Eckelmann, Pyrene Manufacturing Company, Newark, N. J.
Relation of Coating Thicknesses to Service Life on Zinc Die Castings. E. A. Anderson, New Jersey Zinc Company, Palmerton, Pa.
Ductility and Adhesion of Nickel Deposits. F. P. Romanoff, Apollo Metal Works, LaSalle, Ill.
Detergent Properties of Alkalies, Part I. Plating Room Cleaners. N. Promisel, Research Electrochemist, International Silver Co., Meriden, Conn.
Pictorial Study of Plating Conditions. Wm. M. Phillips, Research Engineer, General Motors Corp., Detroit, Mich.
Does Chemical Control of Plating Solutions Solve the Electroplaters' Problems? Geo. B. Hogaboom, Research Engineer, Hanson-Van Winkle-Munning Co., Matawan, N. J.

Wednesday, June 13

Recent Progress in Industrial Cleaning. R. W. Mitchell, Magnus Chemical Company, Garwood, N. J.
Plating Plant Layout. A. J. Lupien, Udylite Process Company, Detroit, Mich.
Copper Cyanide Plating, Its Peculiarities. Elmer Woodmansee.
Concentrated Cyanide Plating Baths. Dr. L. E. Pan, U. S. Research Corp., Long Island City, N. Y.

Thursday, June 14

Rust Proofing before Color Finishing. R. R. Tanner, Metal Finishing Research Corp., Detroit, Mich.
Rubber in the Plating Industry. R. H. Kittner, American Hard Rubber Co., Akron, Ohio.
Some New Developments in Buffing Compositions. Geo. M. Cunningham, National Oil Products Co., Harrison, N. J.
Chromium Plating on Sheet Zinc. Chas. H. Proctor.

Summer Courses in Spectroscopy

Massachusetts Institute of Technology is announcing summer courses in Spectroscopy and its applications, including applications to metallurgy, and a Spectroscopy Conference similar to the one held in 1933 is affording the facilities of its laboratories to research students during the summer for spectroscopic work in connection with their own investigations. Spectrographic examination of materials, except merely routine tests, can be carried out in the laboratories. Further information will be supplied on addressing Prof. G. R. Harrison, Cambridge, Massachusetts.

William F. Sailer, formerly with Alco Products, Inc., and The Griscom-Russell Company, has recently made connections with Steel and Tubes, Inc. He will be located in the Brooklyn Office and will concentrate his efforts on the Oil Refinery and Marine fields.

Edward A. Kreller, Works Manager of The Detroit Gray Iron Foundry and The Detroit Alloy Steel Company, was recently elected to the Board of Directors of the Detroit Alloy Steel Company.

Probability in TIN-PLATE PRACTICE

By Carl B. Post*

IN November 1933, we discussed statistical methods editorially. The utilization of such methods in metallurgical engineering is receiving considerable attention in the A.S.T.M. It will be furthered by the study of concrete examples such as this. We shall be glad to have other accounts of practical application to metallurgy.

Introduction

The metallurgist, as an engineer, must often give assurance that specifications are being maintained, both in the unfinished, and in the finished product. Due to a lack of complete data, he must sometimes give this assurance with some reserved doubt as to the whole of the shipment being good. If a nominal amount of data is to be had on the product, *quantitative* answers can be given to many such problems by an application of the methods of probability, thus giving the answer in a logical manner, rather than by guesswork. Further, by realizing the extent to which probability methods can be applied, the data collected in the usual routine inspection can be coördinated to give a more complete understanding of general mill-practice. The executive metallurgist then has a better knowledge of the product and its fluctuations. The use of statistical methods enables the metallurgist to assimilate this data into a unified state, whereby he is able to deal with fundamental metallurgical facts in a more logical manner.

Examples of the use of probability in control testing and in assimilation of data are becoming relatively common. One such problem relates to the inspection of finished tin-plate stock when the previous standards have been changed. Here the problem is of such a character as to nearly necessitate the use of these methods for a satisfactory quantitative solution. A second example is concerned with the effect of phosphorus on the ductility of tin-plate. In this case verification of several metallurgical facts is obtained by the use of statistical methods. It will be shown that the metallurgist is able to predict the effect of phosphorus on the after-annealing ductility of the particular steel to which the data apply.

A System for the Inspection of Tin-Plate Before Shipment

Before stating this problem in concise words, let us consider the form of the distribution curves obtained for Erichsen values on tin-plate in the after-annealing stage. Here the relative frequency of the various observed Erichsen values are plotted as a function of the Erichsen value, and the relative frequency with which any particular Erichsen value appears is the number of tests having this value divided by the total number of tests. The curves shown in Figs. I to IV represent these distribution curves for various base-weights of several steel specifications. The total number of tests is large and the inspection was carried out over a comparatively long period of time. Several interesting features of these curves will be pointed out in the discussion to follow, but at the outset it should be remarked that these curves represent the final accumulated effect of the innumerable small variations encountered in the manufacture of this tin-plate, that is, variations in the steel analysis, annealing, rolling-temperatures, etc. Instead of becoming bewildered by these small effects, we will use them as a foundation upon which to base conclusions reached by the methods of probability. Since the mathematicians have based this branch of their science upon the recognition of small variations which manifest themselves, in the individual's mind, by a certain amount of doubt concerning the outcome of a particular event, the data, if taken over a comparatively long length of time, will reflect these variations in production, and the answers we obtain will recognize and depend upon these fluctuations.

Suppose the following particular problem has arisen: A customer, using the specification shown in Fig. III(b), suddenly encounters breakage in this plate due to a change in his process. The former standard must be changed so that the minimum Erichsen value acceptable for this customer will be 520. On hand is a considerable amount of plate made on the basis of the old standard (assume all of the Erichsen values shown on this curve to have been formerly acceptable), and, in order to prevent the complaint from becoming serious, precautions must now be taken to see that all outgoing shipments will contain a minimum of bad plate (all plate testing below 520) in each box. Good judgment must be exercised in deciding a box to be bad, because of the cost to the company, and it is here we can give a better quantitative answer to this problem by applying some principles of probability.

As a first step in this problem, we must evaluate the various chances of obtaining varying percentages of bad plate (all plate below 520) in a box of, say, 200 sheets chosen at random from production.* Using the data, represented by the curves of Fig. III(b). Table 1 is obtained for the probabilities of finding certain percentages of bad plate in each box of 200 sheets.

The values represent approximately our state of knowledge concerning the contents of any particular box drawn from stock, that is, we have assigned positive values to our chances of drawing a box having these various percentages of bad plate, *providing the small fluctuations have played their part in the production of this box.* Stated in another way, Table 1 will give the percentage of boxes in stock (if the stock is very large)

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*Weirton Steel Company.

*A discussion of this element of randomness, in addition to all of the mathematical formulae, will be found in the Appendix.

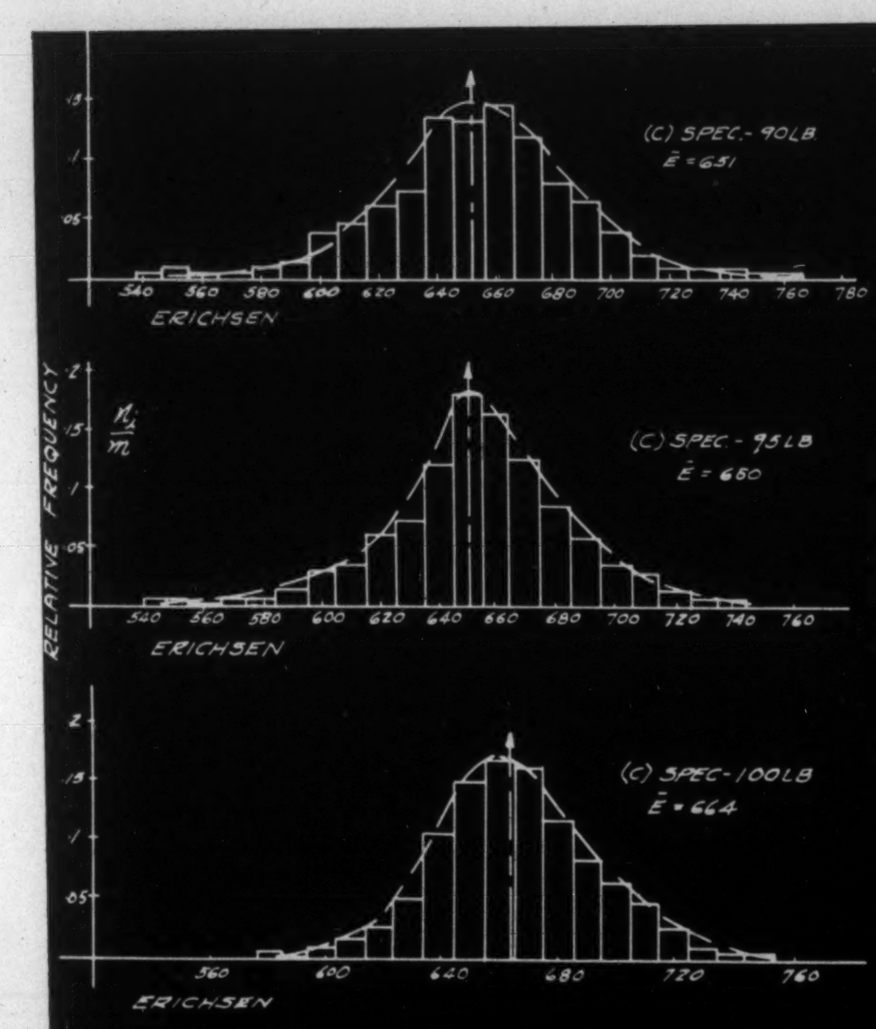


FIG. I

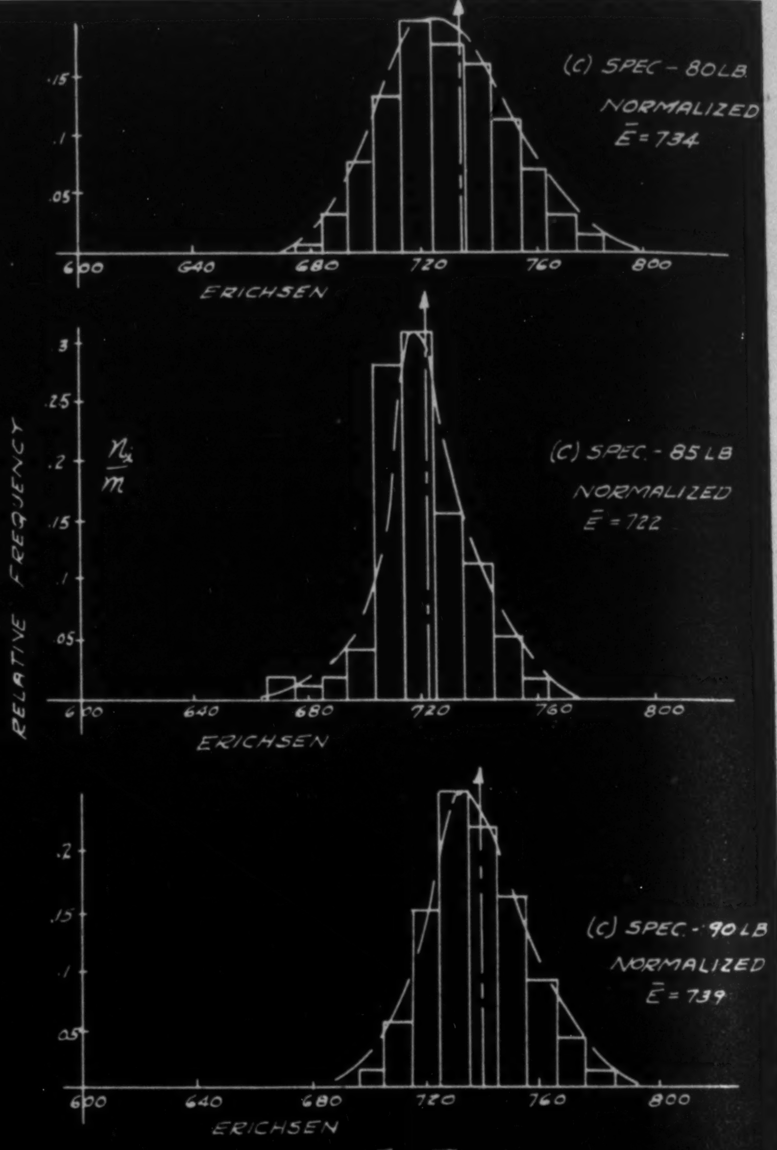


FIG. II

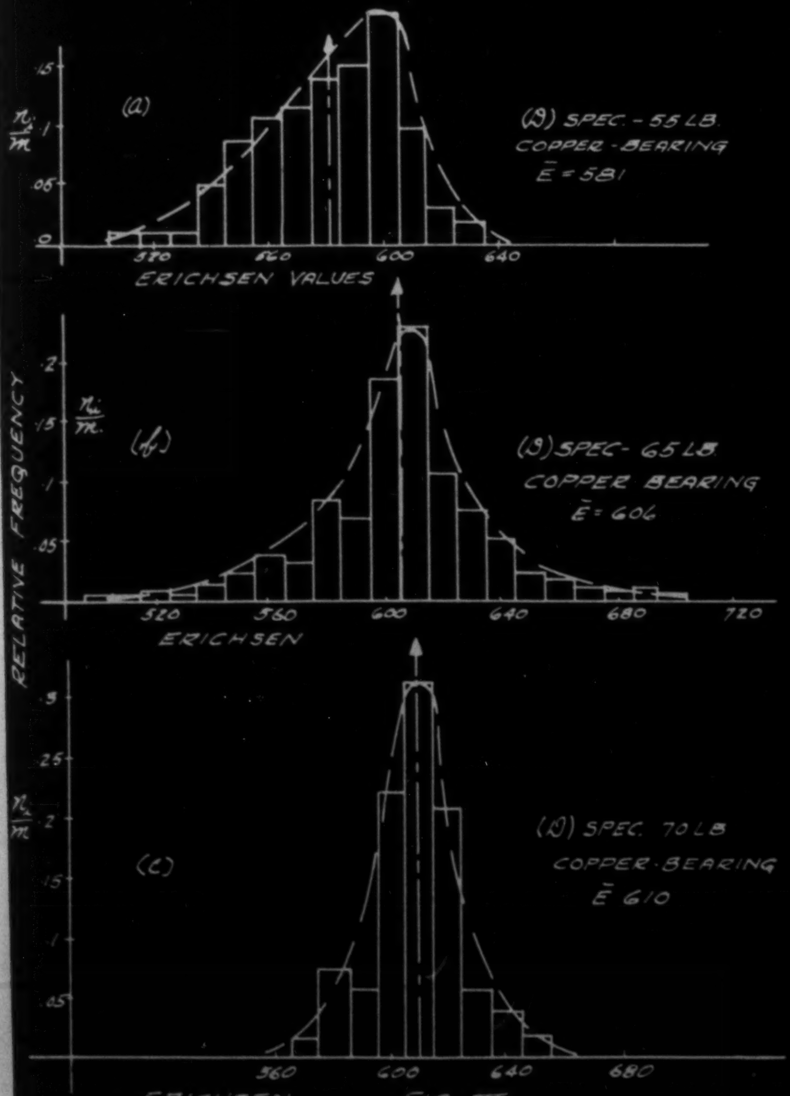


FIG. III

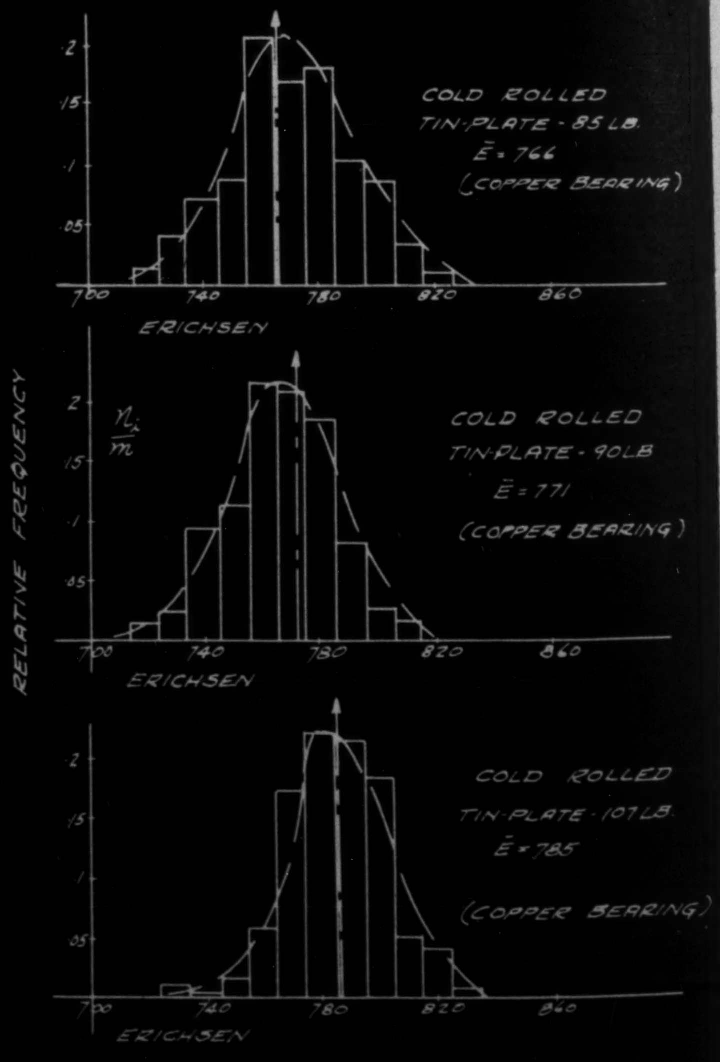


FIG. IV

having these particular percentages of bad plate, that is, 8.3% are expected to have all the plate test above 520, 20.8% are expected to have one sheet in a box test below 520, etc., also, the probability of any particular box having a percentage of bad plate greater than 1% will be the sum of the probabilities below 1%, or approximately 45 boxes out of each 100 are expected to have more than 1% defective plate.

Now let us suppose that 3 sheets are taken at random from a box; we want to determine, from the results of the tests and our state of knowledge about the contents of the box before the drawing of the sheets, whether the box is good (having 1% or less defective) or bad (having more than 1% defective). To the mathematician this immediately calls to mind Baye's Theorem, a theorem having to do with the question: How much have the former probabilities been changed by experiment? If we find 2 sheets bad, say, out of 3 we want to give a quantitative value for the probability that the contents of the box exceed 1% defective, and further, we would like to know the most probable contents of the box, assuming, of course, that the standard of production has been maintained. This value we will calculate for the most probable contents of the box will be the minimum defective sheets to expect, because, if the standard of production had not been maintained for a particular lot (considered as a small part of the total production) from which this box was drawn, then the probability of drawing defective plate will be greater, thus placing our calculations as the limit to which production would tend.

Table 1

Percent of plate having Erichsens less than 520	Probability of box of 200 sheets containing this percentage of defectives
0%	0.0838
½%	0.208
1%	0.258
1½%	0.213
2%	0.132
2½%	0.065
3%	0.0272
3½%	0.00965
4%	0.00302
4½%	0.00008
etc.	etc.

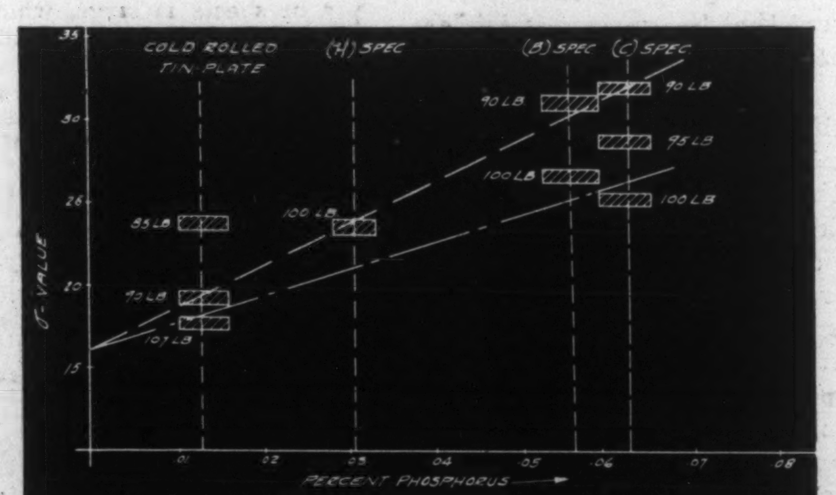
Using the formulæ in the appendix, where a statement of Baye's Theorem will also be found, these probabilities are computed for the cases of 1 and 2 sheets being found bad out of 3 draws. These values are recorded in Table 2, where P(A) represents the chance of having A percent of bad plate in a box *before* the tests (precisely Table 1), while $P_B(A)$ represents the probability that the percentage of defectives is A for the box *after* the results of the tests (the event B) show, say, 2 bad sheets out of 3.

Table 2

A	P(A)	1 bad draw out of 3 $P_B(A)$	2 bad draws out of 3 $P_B(A)$
0%	0.0838	0.000	0.0000
½%	0.208	0.086	0.0000
1%	0.258	0.212	0.0865
1½%	0.213	0.259	0.214
2%	0.132	0.212	0.264
2½%	0.065	0.129	0.216
3%	0.0272	0.064	0.125
3½%	0.00965	0.0265	0.067
4%	0.00302	0.00925	0.0276
4½%	0.00008	0.000273	0.0001
etc.	etc.	etc.	etc.

The chance of more than 1% being bad, in the case of 1 draw out of 3 being bad, is the sum of the probabilities below 1% (nearly 0.7). This is seen to be large enough to warrant the decision that it is highly probable (certainty = 1) for the minimum number to be exceeded, while if the trials had resulted in 2 bad sheets out of 3, then the chance of the percentage of bad sheets exceeding 1½% is very probable (nearly 0.7), and it is almost certain that the percentage exceeds 1%.

This method of computation can be extended into a system of control for all of the specifications; control charts can be made from the calculations so that a speedy decision can be given. The method of control will vary according to the conditions of the product, and for this reason no attempt is made here to discuss this point further. This problem, at the most, is only given as an example of the method of attack on problems of this type. The results of the final computation have been obtained by assuming that the whole of the distribution curve for the after-annealing stage is shifted by a known amount to larger Erichsen values in the tinned-stage, but in view of the nature of the problem, the computation will suffice for a first approximation.



THE BREADTH OF THE BLOCKS INDICATES THE ALLOWABLE PHOSPHORUS VARIATION IN OPEN HEARTH SPECIFICATIONS

FIG - V

The Spread of the Erichsen Distribution Curves as a Function of the Phosphorus Content

In the study of these distribution curves for Erichsen values, it was noticed that for any particular baseweight the spread, or dispersion, of the curves increased as the phosphorus content increased, provided the other chemical elements remained approximately constant. In order to verify this observation we must consider the "distribution of deviations" derived from the above curves.

For every Erichsen value E_1, E_2, . . . , there corresponds a deviation:

$$\begin{array}{l} \delta_1 = E_1 - \overline{E} \\ \delta_2 = E_2 - \overline{E} \\ \quad\vdots \qquad \vdots \qquad \vdots \\ \delta_i = E_i - \overline{E} \end{array} \quad \text{, where } \overline{E} = \frac{\sum_1^n E_i}{m}.$$

Now a distribution of deviations may be formed by considering the above set of δ's as a new distribution with an arithmetic mean $\overline{\delta}$, a median, a mode, and finally, a root-mean-square deviation,

$$\delta_{r\cdot m\cdot s\cdot} = \sqrt{\frac{\Sigma n_i \delta_i^2}{m}} = \sqrt{\mu_2(\delta)}.$$

It is easily seen that the distribution of δ's is equivalent to shifting the origin to the arithmetic mean. The root-mean-square value in statistical work is called the "standard deviation," represented by the symbol σ. The importance of this value is the fact that it is taken as the measure for the spread of the curve. Table 3 gives the σ-values for several of the distribution curves of Figs. I to IV.

Table 3 σ-Values

	55 lbs.	65 lbs.	70 lbs.	80 lbs.	85 lbs.	90 lbs.	95 lbs.	100 lbs.
Cold Rolled Tin Plate	....	....	....	18.7	23.7	19.1	....	....
(C) Spec.	....	....	....	....	....	31.65	28.5	28.1
(D) Spec.	24.1	30.2	15.7	....	....	....	....	....
(H) Spec.	....	....	....	....	....	....	25.0	....
(B) Spec.	....	....	....	....	....	30.8	....	26.5

The graphical representation of the spread as a function of the phosphorus content is shown in Fig. V. It is seen that the above observation holds in a numerical sense, and in addition, it is seen that the lighter base-weights have the greater spread, as is to be expected. Of course, the specifications shown were chosen because of the equality of the other chemical elements. In the annealing of these various specifications, very little attention was given to the difference in chemical composition, so that in the long run, the specifications will have approximately the same commercial anneal.

The interpretation of these results can be construed to indicate that the presence of phosphorus has a very profound effect upon the ductility of tin-plate and steel in general. From this it follows that heats having a higher phosphorus content will display a greater variation in ductility, about some average value, than heats having a lower content. This is a plausible assumption in view of the variation in chemical analysis in various sections of an ingot. Another interpretation could be given by the assumption of the high phosphorus heats being more difficult to anneal than the lower ones. But in view of the previous statement that the various specifications had approximately the same anneal, the former seems the more plausible.

This is an important question with any tin-mill because of the problem of hot-mill stickers in opening the packs. It is well known that the presence of phosphorus in tin-plate will reduce the sticker cost, and it is equally well known that the presence of large amounts of phosphorus in the steel will lower the ductility, but it has been assumed by metallurgists that unless the amount of phosphorus present is relatively great, the ductility is not lowered to a marked extent. The results shown here can be applied to this problem by predicting the spread of the distribution curve for any particular steel specification, and from this, conclusions can be drawn as to the amount of phosphorus any given specification can stand without seriously affecting the previous standards. This is valuable information for the metallurgist to have because he has previous set standards for various customers, and if the standard should happen to be near the average value of the distribution curve, then trouble will be experienced in holding the same specification, but with higher phosphorus content, in the range of values where the annealing is effective for the customers' particular demands.

Conclusions

Although the examples discussed here are necessarily meagre in details, it is hoped enough information has been given to show the applicability of probability methods to some problems of the metallurgist. The problem presented for the sampling operation is of a general type, but it is felt the discussion and numerical will help anyone interested in this field. The variation of the spread of the Erichsen distribution curves with phosphorus content appears to be worthy of further study because of the phosphorus problem in any tin-mill. It is believed the results found here will serve as an indication of the usefulness of statistical methods in the search for basic metallurgical facts.

Mathematical Appendix

Before discussing the equations to be used, it would be well to examine the conditions to be satisfied before the methods of probability can be applied. The element of randomness, so important as a basis for probability, is obtained to a certain degree by the mixing of the various heats, retinning of menders, and their subsequent resortment into lots. This degree of randomness is not extensive, but it is sufficient to allow evaluation of certain questions with a fair degree of accuracy. Many other types of examples, having a greater degree of randomness, could be chosen for the problem on sampling, but the one selected is taken for its own importance and not as a method the metallurgist could use in other cases without first making certain corrections dependent upon his product. In the outgoing shipment we will be concerned with primes and seconds but our statistics will not distinguish between the two kinds in regard to the relative frequency of Erichsen values.

Using the results of the curves in Figs. I to IV, for any particular specification and base-weight we may calculate the probabilities of particular percentages of badness, or rather the minimum percent to be expected, in a lot drawn from the supply of tin-plate to which the curves apply. In general, let x_o be the lowest recorded Erichsen value on one of these curves for a particular specification, X the largest value, and x_1 a value below which Erichsen's will be considered bad, while those above it will be considered good. Then the relative frequency of bad plate to be expected (using the data of the curves) will be given by,

$$\frac{\sum_{i=x_0}^{i=x_1} n_i}{m}, \text{ where } \begin{aligned} n_i &= \text{number of tests having an Erichsen } x_i, \\ m &= \text{total number of tests.} \end{aligned}$$

while the probability of obtaining good plate on a draw is,

$$\frac{\sum_{i=x_1}^{i=x} n_i}{m}.$$

For these relative frequencies to be true it is necessary for the number of tests to be large. Now if it is assumed that the supply of sheets is large, which would be true if the inspection were concerned with specifications having large orders, or if the supply is constantly being replenished, thus making these frequencies approximately the same, then the probability of drawing *a* bad sheets in *b* trials (the probability of drawing a single bad sheet in one trial is p) will be given by:[1]

$$P_b(a) = C_a^b p^a (1-p)^{b-a}, \qquad (1)$$

where C_a^b represents the total number of combinations of *b* things taken *a* at a time. This will give us a formula for the computation of the probabilities of various percent of bad plate in a box. Using the data of Fig. III(b) the symbols will have the following values: b = 200; a = 1 for ½% badness, 2 for 1% badness, etc.; $\frac{\sum_{i=x_0}^{520} n_i}{m} = 0.0124$, and $\frac{\sum_{520}^{i=x} n_i}{m} = 0.9876$.

Rewriting equation (1) in the form

$$P_b(a) = C_a^b \Big(\frac{\sum_{i=x_0}^{i=520} n_i}{m} \Big) \Big(\frac{\sum_{i=520}^{i=x} n_i}{m} \Big), \qquad (2)$$

this calculation could be given for these percentages, but it will be found that the cumbersome calculation of $C_{1.2}^{200}$ will necessitate the use of an approximation formula. It can be shown[2] that if p is very small and *b* is very large, a very good approximation can be given to the above expression (the Binomial Law) by Poisson's Law:

$$P_b(a) = \frac{e^{-\epsilon} \epsilon^{a}}{b\,!}, \text{ where } \epsilon = mp. \qquad (3)$$

Using this approximation, where the symbols have the same meaning as in (2), the results of Table 1 follow at once.

Baye's Theorem[3] can be given the following form:

$$P_B(A) = \frac{P(A)\, P_A(B)}{\sum_A P(A)\, P_A(B)}, \qquad (5)$$

where the formal, and particular, meanings of the symbols as applied to our problem are:

The Event A....	Occurrence of the various possible percentages of bad plate in a box, shown in Table 1.
The Event B....	Finding, say, of 2 bad sheets out of 3 draws from a box.
$P(A)$	A knowledge of the occurrence of B is not known, P(A) is the probability of the occurrence of the percentages shown in Table 1.
$P_A(B)$	A is known to have happened, this is the probability that it was followed by B; assuming certain percentages of bad plate in the box we can calculate the chance of drawing, say, 2 bad sheets out of 3.
$P_B(A)$	B is known to have happened, this is the probability of it being preceded by A; if the tests show 2 bad draws out of 3 this will be the probability of the box containing A percentage of bad plate.

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[1] T. C. Fry. Probability and Its Engineering Uses. Pages 62-63; Coolidge. Probability, pages 13-25.

[2] Fry. Reference 1, pages 214-217.

[3] Fry. Reference 1, chap. 5.
Arne Fisher. Mathematical Theory of Probabilities. Pages 54-67.
Czuber. Wahrscheinlichkeitrechnung. Pages 189-210.
Laplace. Theorie Analytique des Probabilities. Chap. 6.

(Continued on Page 95)

IS There a Test for MACHINABILITY?

by H. W. Graham*

No. 4 in a series of Case Histories in Metallurgical Research

IN THE January issue of *Metals & Alloys* there appeared the first of a series of articles on research. In this prelude to the case histories to follow, Dr. Gillett pointed out at some length the utility of negative results. It is a matter of coincidence that during the same month the writer was reviewing records having to do with 15 years of research on the machinability of free-cutting steels. These data make up a story of the unsuccessful phases of the efforts of one group of workers in this particular field. However, these efforts have added much to the background in the broad field of machining and thereby have contributed to the improvement in the free-cutting qualities of screw steel during the last 15 years.

In the following story of negative research, many of the points covered are of little or no value for further work, but are still regarded by many as points of positive value in the field of machinability because of their utility in permitting other workers to avoid some waste of time.

This story properly begins when the writer was directed to undertake an exhaustive study of the Bessemer process as applied to the manufacture of Bessemer screw stock. It has remained our major thesis throughout subsequent years, partly by reason of assigned duties and partly because of keen personal interest in the intricacies of the subject.

During all of this time, we have been fortunate in being able to observe the manufacture of huge tonnages of free-cutting steel, to follow the performance in the customers' plants, and further, and most important, to view screw stock problems in relation to pig-iron manufacture and steel-making by the Bessemer, duplex, basic open-hearth, and acid open-hearth processes, the products of which found their way into the manifold uses to which carbon steel is applied. Because of this fortunate placement we were able to overcome many of the errors of thinking that would have been less evident under circumstances of narrower vision.

At the very outset of our own research work on Bessemer screw steel, we were faced with reports from the trade that were not reconcilable with our previous ideas of quality requirements and test procedure. A given customer would report that a certain heat of steel machined very poorly and the common tests of that day would give no indication of any lack of quality in the steel. Under such circumstances we were apt in earlier days to tell the customer that he was trying to machine the bars too rapidly or that his tooling and coolant practice was poor; but in recent years we have entirely abandoned any such attitude.

From the beginning of our research in Bessemer screw steel, it was recognized that progress would be facilitated by the development of a simple test to determine the degree of machinability of a steel. In our work toward this objective, many methods, including some twenty-five of our own, have been thoroughly explored in our laboratories and all discarded. All of these tests were appraised on the basis of their value in measuring machinability of only those low-carbon, high sulphur grades which are properly regarded as free-cutting steels.

Blowing a Bessemer Heat

The ideal condition for good machinability is represented by a steel which is soft and brittle, and which does not harden greatly during deformation to rupture. Bessemer steel answers this specification admirably except that it has a fairly high order of work hardening capacity.

The efforts of many investigators have revolved around the belief that hardness can be used to measure machinability. It was only natural that those who held this belief would try to apply the Brinell test, and probably hundreds of thousands of Brinell impressions have been made by hundreds of investigators seeking a correlation with machinability. While it may be that the Brinell test is of value in dealing with machining problems on heat-treated parts of forging steel, Brinell tests cannot be depended upon for satisfactory testing of free-cutting steel.

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*General Metallurgist, Jones & Laughlin Steel Corporation.

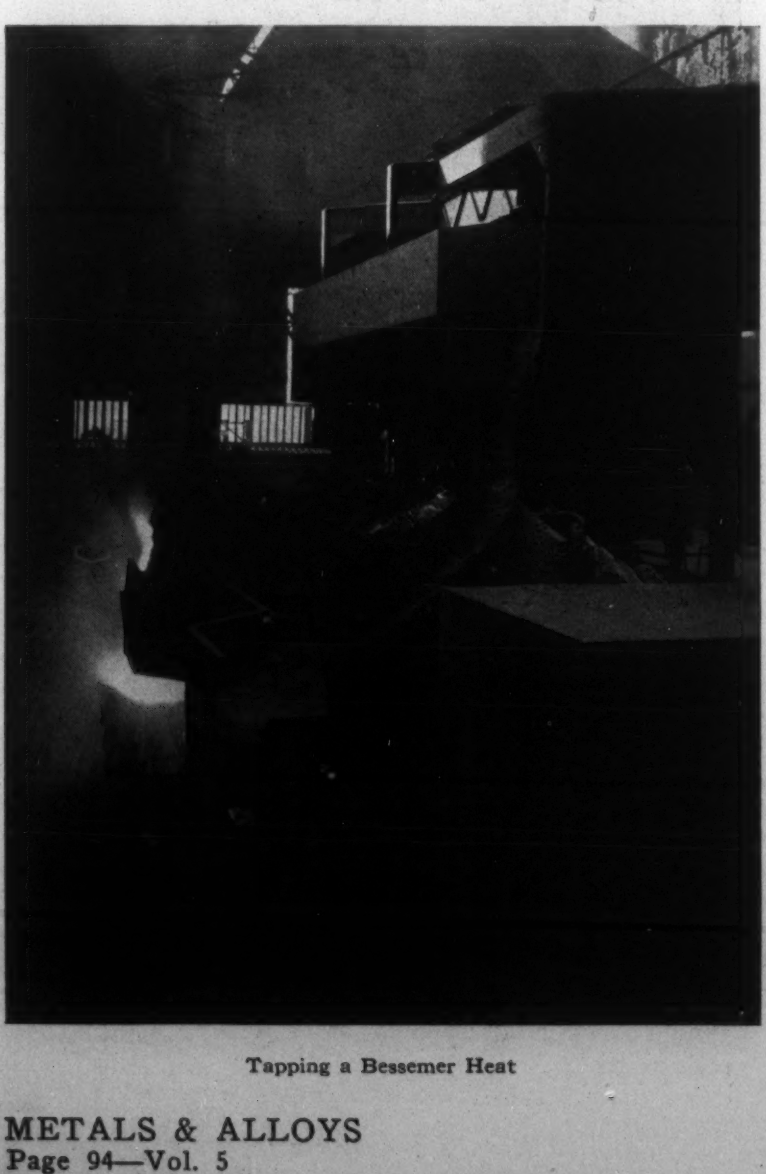
In our search for a simple test we hit upon an idea that for the moment seemed wonderfully promising, namely: to Brinell a bar, then Rockwell the bar both in the Brinell impression and on an unworked spot, using the ratio of the two Rockwells as a gage of machinability. The results were a flat failure. While the test did involve a measurement before and after cold working, the procedure involved work-hardening by slow compression instead of by rapid shear as in a cutting operation.

A progressive form of this combined Rockwell and Brinell test has been suggested recently by Dr. Sauveur. It has a certain usefulness in measuring the sensitivity of steel to work-hardening but the results must be viewed in the light of the limitations of the test. In any case the test can have no great value in studying machinability. In fact, our investigations have shown conclusively that work-hardening is only a part of the story of machinability, and therefore dependence upon work-hardening data is apt to involve disappointment to the research worker.

Realizing that static tests such as the conventional Brinell or tensile tests are not discriminatory, we rigged up a drop test to make impact indentations with a standard Brinell ball. Some rather weird results were obtained, and, while the test did have some worth which we never completely evaluated, we finally gave up the effort to associate the results with machinability.

We also tried impact tensile tests, without value as relates to a measurement of machinability.

In the early days of our investigation we naturally attempted to apply the tensile test to a study of machinability, but without success. The tensile test is essentially a static test and, therefore, is in no sense comparable to a cutting operation. Further, it is a fundamental point that cutting is a shearing operation in compression; and while the tensile test involves shear, it is shear in tension, and at a rate of application of force which in no wise approaches that which obtains in automatic screw machine operation. After considerable work we came to the conclusion that the tensile test would be of no help in evaluating machining quality.



Tapping a Bessemer Heat

At one time in our investigations we came to feel that some fundamental of steel quality not unassociated with machinability would be disclosed by a study of the varying ratio of tensile strength and shear strength. The results were promising but the tests required considerable preparation for a single determination and the effort was finally abandoned.

As early as 1924 we did some experimental work with a simplified laboratory milling cutter. A little later we set up a special drill press for work somewhat along the lines of that followed by certain drill manufacturers. Within the last year we have also done some investigational work with Prof. Boston's dynamometer.

We have also given considerable study to the possibilities of ultra-rapid photography as applied to the operation of metal cutting. This field has been well explored by Prof. Schwerd of the Technische Hochschule at Hanover, Germany, who has done some brilliant work in ultra-rapid motion pictures of high-speed cutting. The method of study is fascinating although the technique is most difficult, and it was with some regret that we came to the conclusion that this line of study would lead us along a by-path of the main line of our endeavor.

In 1927 we came to the conclusion that the way to measure the cutting quality of steel would be to secure a machine, put steel bars in it, and proceed to cut them. Accordingly, a four-spindle Acme automatic was installed, with cams for making cap screws and the battle was on. From that date to the present time this machine has been operated almost continuously.

One of our efforts with this automatic was the measurement of power consumed. Obviously there must be a correlation between machinability and power consumption, but the amount of power usefully applied at the tool tip is a relatively small proportion of the total input to the driving motor. Lubrication and mechanical conditions interfered with the use of a watt-meter to measure machinability, and we finally abandoned the venture.

While numerous methods have been used on this experimental automatic, one that has been extensively applied is to run the screw machine without cutting compound and note the time required to burn the tool. This is essentially the method used by Taylor at Bethlehem early in this century in testing tool steels.

By this method considerable information has been obtained which has had the appearance of portraying the machinability of free-cutting steel. While it is obviously expensive, since the automatic is "chewing up" steel and making no salable product, yet this machine has been considered a good investment because of the help it has given our steel makers in maintaining the quality of our free-cutting steel. Paradoxically, however, we have come to the point of view that an automatic screw machine, even under laboratory conditions, does not satisfactorily measure machinability. It does furnish some indication of cutting quality, but the error involved may perhaps be as much as ± 10%, which is probably not greater than the variation in machinability of a considerable proportion of the heats of steel supplied to the trade by a given manufacturer.

One of the first tasks of any importance in our study of machinability fifteen years ago involved a complaint on cutting quality from a prominent customer. The customer's metallurgist was at that time engrossed with the idea that all machining trouble arose from a certain type of occurrence of alumina inclusions. This started us on a metallographic study which did not settle the technical question, but which did prove that the steel that caused trouble had not been made by us. This ended that complaint, but, unfortunately, difficulties do not always have such simple and non-technical solutions.

In the course of metallographic investigations, naturally our attention was turned to the matter of grain size. This study led us to the conclusion that better machinability is, in general, associated with the coarser grain sizes. However, it is important to note that at any given grain size, there exists a great degree of variability in machining performance. Our present point of view is to consider that cutting quality is directly dependent upon certain fundamental characteristics of the steel ingot, which are also largely the basis of varying grain size. But, there is a rather long path of processing between the steel ingot and the automatic screw machine, and as the steel goes through this long processing, cutting quality is affected by one set of conditions and grain size is affected by another group of influences. Hence, a correlation between grain size and machinability may have been relatively direct in the ingot but is rendered loose and undependable by the processing history of the steel.

Over a period of years considerable effort has been devoted to the metallographic study of the formation of the chip. Our view is that it is impracticable to obtain specimens that accurately represent conditions as they exist in automatic screw machine operation.

Indications obtained in this work have, however, directed our attention to the importance of the depth of penetration of a cold-working in the cutting operation. While we are convinced that there is a direct and dependable correlation between cutting quality and the depth of penetration of the cutting force, we have not as yet discovered any way to overcome the fact that a steel specimen must be cold worked in preparing it for metallographic examination. This subject is still under study in our laboratories.

These 15 years have been full of disappointments as many hopeful ideas have turned out to be incorrect, impractical, or useless. We have accumulated a huge bulk of negative data, but certainly also tremendously valuable positive information. In these 15 years the manufacture of free-cutting steel has progressed from a wholly rule-of-thumb processing to a point of greatly improved quality produced under technical supervision with a background of a substantial knowledge and understanding of fundamental principles.

Cold Drawing Steel Bars

Probability in Tin-Plate Practice

(Continued from Page 92)

In evaluating $P_A(B)$ for the various percentages from Table 1, it is easily seen that due to the small number of defective sheets to be expected in a normal box, the trials will not be independent of one another, as in the computations for Table 1. For this purpose we must use a formula concerned with dependent trials: If the group of m things of one kind and n things of another exists, and if the group is reduced by eliminating one thing at a time (random choice), the probability that the first p + q stages will remove p things of the first kind and q of the second is

$$P_{m,n}(p,q) = \frac{C^m_p \, C^n_q}{C^{m+n}_{p+q}}. \tag{4}$$

Here m = 1, 2, 3, etc., n = 199, 198, 197, etc., p = 1, q = 2 (for the case of 1 bad draw out of 3).

In general the formula for the computation of the final probabilities will be:

$$P_B(A) = \frac{P(A)\, P_{m,n}(1,2)}{\sum_A P(A)\, P_{m,n}(1,2)}, \tag{5}$$

and canceling some obvious factors, we get

$$P_B(A) = \frac{P(A)\, C^m_1 \, C^n_2}{\sum_A P(A)\, C^m_1 \, C^n_2}, \tag{6}$$

where m = 1, 2, 3, . . . when A = ½%, 1%, etc. Actual computation will give the results shown in Table 2.

At a meeting of the Board of Directors of The Riverside Metal Company, held March 23 John F. Hackett was elected Vice President of the Company. Mr. Hackett has been General Manager of The Riverside Metal Company since 1920. For the preceding 7 years he was Superintendent of the Seymour Manufacturing Company.

Rapid Determination of

Oxide in Molten Steel

by

A. B. Kinzel[1], J. J. Egan[2] and R. J. Price[3]

THE role played by the oxide content of a steel bath during various stages of refining is receiving increased attention from the steel maker. Increased knowledge of the chemical reactions involved in steel making relates the qualities of the final product to the oxide content of the bath and further relates this oxide content to the slag composition. Thus, it is common practice to control the oxide content of the steel by predetermining the slag analysis. However, no method for directly determining the oxide content of the bath has been available for the steel maker to use during the course of the heat. All previous analytical methods have required too much time for such application and it is generally agreed that a method for determining iron oxide in molten steels rapidly would be of great value. This problem was accordingly studied at the Union Carbide & Carbon Research Laboratories. Various methods are being investigated and that here described has been brought to a sufficient state of perfection to warrant its consideration for use in the open hearth furnace plant. It involves the conversion of iron or other oxides to alumina, together with an improved rapid determination of the alumina content. Essentially it is an improvement of the Kichline[2] and Herty[1] procedure.

The use of aluminum for killing spoon samples for analysis requires a special procedure and difficulties have been experienced in some mills. However, a sufficient number of users have found the method satisfactory so that it may be safely assumed that with proper technique the oxygen content of the steel bath may be quantitatively fixed in the form of alumina in the sample. It is believed that pouring over aluminum wire with careful blocking of the slag is the most suitable means for avoiding difficulties.

Some question has been raised as to the quantitative formation of alumina if silica or silicon is present in the molten steel. Our experience indicates that the alumina is formed quantitatively and that no appreciable error is to be expected from this source. It might be further mentioned that the presence of highly stable carbides such as tungsten carbide will interfere with the analytical procedure. However, there is generally no occasion for running a rapid analysis when such stable carbides are present.

The sample having been obtained in small ingot form, drillings are taken in the usual way and subjected to the improved analytical procedure. In essence, this consists of dissolving the steel in nitric acid containing ammonium persulphate, adding a small quantity of specially prepared carbon, concentrating the solid matter in a hand centrifuge, decanting and filtering the concentrated residue, igniting in an oxygen atmosphere and weighing. The entire analytical operation takes 7 to 10 minutes depending upon the skill of the analyst. A description of the procedure together with the discussion follows.

5 g. of fine steel drillings are added to 250 cc. of 30% nitric acid warmed to 30°C. and contained in an 800 cc. covered beaker. It is essential that the drillings be comparatively fine as large pieces will unduly increase solution time. The steel is immediately followed by 15 g. of ammonium persulphate. On completion of solution 15 cc. of hydrochloric acid (specific gravity 1.19) and 0.05 g. of ashless lamp black held in suspension in 20 cc. of water are added and the whole vigorously stirred. With properly prepared drillings the solution time of the 5 g. sample will be approximately 2 minutes.

Nitric acid is used instead of hydrochloric, as recommended by Kichline,[2] as it dissolves the steel much more rapidly and without attacking the alumina. Care should be taken not to heat the acid above 30°C. Acid heated to the boiling point will dissolve some of the alumina. Ammonium persulphate is added to the acid in order to increase carbon solution. It is particularly important in high carbon samples where large carbon flakes interfere with the speed of the following operations. The ashless lamp black is added in order to facilitate the subsequent centrifuging. The lamp black in suspension should be previously filtered by centrifuging commercial lamp black several times with intermediate decantation.

The solution which now contains alumina, carbon from the steel, and added carbon as solid matter is then centrifuged. This operation is carried out in a hand centrifuge at about 1800 r.p.m. for one minute. The 2-bulb type, each bulb containing 175 cc. is preferable. The supernatant liquid is decanted, leaving the precipitate in approximately 10 cc. of liquid. This entire operation should take approximately 1½ minutes, very materially reducing the time necessary for the subsequent filtering operation. This should be carried out using two #42 superimposed Whatman papers (6 cm.) with gentle suction; a small amount of ashless paper pulp is used in the apex and the papers are supported on a small platinum cone. The precipitate is washed with warm 5% hydrochloric acid and transferred to a flat-bottomed platinum dish. Due to the special preparations that have been made in the previous step of the procedure the filtering time should not exceed one minute.

The contents of the platinum dish are ignited in a small furnace at approximately 900°C. The muffle should be flushed with pure oxygen before the dish is put in, and the stream of oxygen should be maintained during the ignition in such a fashion that no direct gas current impinges on the inside of the dish. This is essential to

(Continued on Page 106)

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[1] Chief metallurgist
[2] Metallurgist
[3] Chemist
Union Carbide & Carbon Research Laboratories, Long Island City, N. Y.

[1] Herty, Freeman & Lightner. *Bureau of Mines Reports of Investigations,* No. 3166, Apr. 1932.

[2] J. Kichline. *Industrial & Engineering Chemistry,* Vol. 7, 1915, page 806.

ZINC DIE CASTING ALLOY

Aging Data

by E. A. Anderson* and G. L. Werley**

DURING the past few years much data on the properties of zinc die castings have been published by the writers and by others. It has become apparent that due to the special nature of the tests employed in studying these alloys some confusion exists as to just what the data mean in terms of the practical application of these alloys. It is hoped in the present article to clarify the situation.

Before proceeding with the major points of discussion it may be well to point out that the tests used today originated, to a considerable extent, in the earlier days of the zinc die casting industry when major changes in properties of the alloys then in use were to be expected under a large number of service conditions. Their continued use today is to some extent of value only as a guarantee that such old-time alloys are not being offered.

There are 2 major sources of change in properties and dimensions to be studied; intergranular corrosion and internal phase adjustments. It is possible that the two may be inter-related to some extent but one may exist without the apparent presence of the other. Any attempt to determine the value of a given alloy for a particular set of service conditions must include an estimate of the likelihood of one or both of these factors existing under the expected conditions of use. It is for the purpose of furnishing data applying to this problem of alloy selection that the special tests to be discussed are employed.

The changes which occur in zinc-aluminum alloys giving rise to both dimensional changes and changes in physical properties are well known and have been the subject of a great deal of investigation. It is pretty well understood throughout the industry and by metallurgists generally, that the changes due to the peculiar type of corrosion known as intergranular corrosion do not have to be reckoned with for any ordinary use of the modern zinc die casting alloys.

However, even these modern alloys are subject to physical changes which do have to be taken into account. This is true to a greater extent for some alloys than for others but to some extent for all of them. These changes are complicated in their effects and the causes are not well understood. The purpose of this paper is to explain as clearly as possible the practical effects of these changes without going into the question of their causes.

Dimensional Changes

The most important effect of the physical changes which occur in the alloys is the dimensional change, though the hardening of some of the alloys with an accompanying drop in impact strength is in some cases equally or more important. The dimensional change reflects most delicately the underlying changes and so will be discussed first.

If we take a 6-inch long bar of any of the standard present day zinc die casting alloys[1] (all of which contain aluminum) and record to an accuracy of 0.0002 inch the changes in its length, from the time it is cast, over a period of 6 months we find a marked similarity among the results for the different alloys.

In Fig. 1 are plotted the results of such tests for 4 alloys. In every case a shrinkage occurs rapidly during the first 4 or 5 weeks but at a diminishing rate in which further change becomes practically immeasurable after 5 weeks. So far as this particular change is concerned the castings are in a stabilized condition after 5 weeks at room temperature.

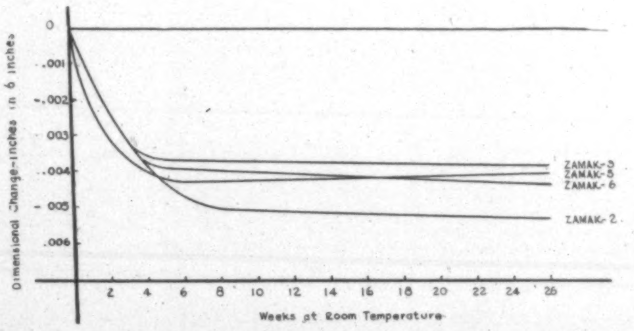
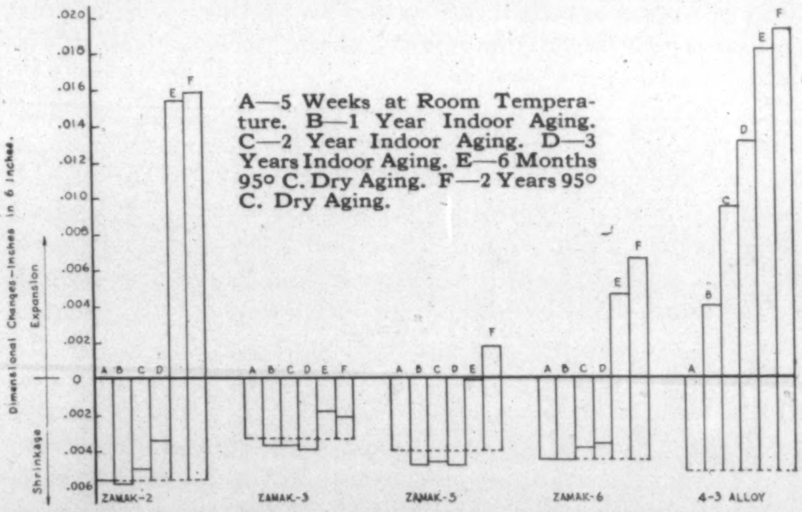


Fig. 1. Extent of Rapid Dimensional Changes in Zinc Die Casting Alloys.



A—5 Weeks at Room Temperature. B—1 Year Indoor Aging. C—2 Year Indoor Aging. D—3 Years Indoor Aging. E—6 Months 95° C. Dry Aging. F—2 Years 95° C. Dry Aging.

Fig. 2. Dimensional Changes Occurring in Zinc Die Casting Alloys During Aging at Room Temperature and at 95° C.

If we continue these observations as has been done in Fig. 2† for a period of 3 years we find that Zamaks 2 and 6 have started to expand at some time between 6 months and 2 years while Zamaks 3 and 5 have not changed after one year.

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[1] The alloys considered in the present article are identified as follows:

Trade Name	Nominal Composition Aluminum	Copper	Magnesium	Zinc*
Zamak-2	4.1	2.9	0.04	Balance
Zamak-3	4.1	None	0.04	Balance
Zamak-5	4.1	1.0	0.04	Balance
Zamak-6	4.1	1.25	None	Balance
4-3 Alloy	4.1	2.9	None	Balance

*Zinc 99.99+% pure.
Zamak-2 meets A.S.T.M. Alloy No. 21 and S.A.E. Alloy No. 901 specifications.
Zamak-3 meets A.S.T.M. Alloy No. 23 and S.A.E. Alloy No. 903 specifications.

†In Fig. 2 the zero line is based on measurements taken on the specimens shortly after casting. The distance from this line to the solid cross bars gives the dimensional change in unstabilized castings occurring in any given test. The dotted line represents the shrinkage occurring in the five week period described above (see Fig. 1). The extent of dimensional change in stabilized castings can be determined for any test by measuring the distance from the dotted line to the solid cross bars.

If we raise the temperature, say to 95°C., as a logical means of accelerating these changes we find that the contraction which required several weeks for completion at room temperature occurs in about 3 hours and that the rate of the succeeding expansion in the case of Zamak 2 and Zamak 6 is greatly accelerated. Moreover, Zamaks 3 and 5, which showed no measurable expansion in 3 years at room temperature, show a small but definite expansion after 6 months with a further increase after 2 years for Zamak 5 but none for Zamak 3.

It is obvious then that the dimensional changes observed in these alloys may vary appreciably depending on the interval between actual casting and the first measurement. Thus, if a Zamak 3 casting is 5 weeks old when first measured, the maximum dimensional change that would be observed after several years of aging or even after indefinite exposure to 95°C. will not exceed 0.0012 inch in a 6-inch length. The same thing will be true if the casting is aged (stabilized) for 3 hours at 95°C. Practical use may be made of this fact by using such a stabilizing anneal prior to finish machining.

There is no way of presenting data concerning the dimensional changes occurring in these alloys which does not involve the risk of being misleading except to give some sort of time versus dimensional change graph as in Fig. 2. It is probable that most castings are over 5 weeks old and hence past the period of rapid initial shrinkage when put in service. For this reason the authors have in the past presented data based on "initial" measurements made 6 months after casting when this shrinkage is complete. Fig. 2 gives a more complete picture, however.

Perhaps we should pause here to reassure users of die castings by pointing out that the changes under consideration are of very small magnitude and ordinarily are of no significance. However, the increasing use of die castings where tolerances in the 10 thousandths must be met make these refinements in the presentation of the data necessary.

Examination of Fig. 2 with reference to alloy composition makes it evident that copper plays a vital role in the behavior of these alloys subsequent to the initial shrinkage. Zamak 2 which contains 3% copper undergoes the greatest change, Zamak 6 with 1.25% copper is next, Zamak 5 with 1% copper shows little change and Zamak 3 free from copper almost no change even at elevated temperature for periods up to 2 years.

The steam test should be considered at this point. The alloys containing magnesium, Zamaks 2, 3 and 5 are, if the composition is in accordance with the specification, free from intergranular corrosion. Even Zamak 6, containing no magnesium but like the others made with very pure zinc, is comparatively free from this type of attack. Nevertheless, all of these alloys will, if contaminated, become subject to intergranular corrosion when exposed in warm humid atmospheres.

As a direct test to detect susceptibility to intergranular corrosion caused by improper composition the so-called steam test (an atmosphere saturated with moisture at 95°C.) is valuable. A parallelism between long tropical exposures and short exposures in the steam test seems to exist up to 10 days in the steam test. Beyond this period of test the parallelism ceases due to the excessive acceleration of surface corrosion of zinc alloys in steam as compared to the normal surface corrosion occurring in actual tropical atmospheres. Beyond this period the test becomes valuable only as a direct nonaccelerated test of resistance to steam.

It is evident from what has gone before that the steam test will bring about changes due to the temperature effect alone and that the effect due to corrosion is the total effect minus the temperature effect.

Mechanical Properties

The internal reactions responsible for the dimensional changes just discussed are reflected also in changes in such mechanical properties as impact strength, tensile strength, etc. As in the case of the dimensional changes certain of the changes in mechanical properties occur at a rapid rate in the period of 4 or 5 weeks immediately following the casting operation. Following this stabilization period some of the alloys show no further changes while others suffer slow losses in ductility over fairly long periods of time.

Impact Strength

The effects on impact strength of dry aging both at room temperature and at 95°C. are shown in graphic form in Fig. 3. As a matter of interest data on the 4-3 alloy (4% aluminum, 3% copper, balance 99.99+ pure zinc) are included. This alloy at one time was the best available.

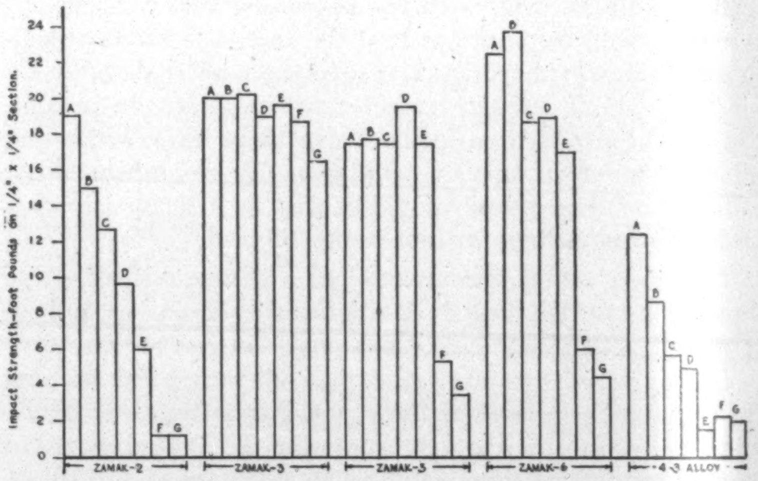

Fig. 3. Effect of Room Temperature and 95° C. Aging on the Impact Strength of Zinc Die Casting Alloys. A—As Cast. B—5 Weeks at Room Temperature. C—1 Year Indoor Aging. D—2 Years Indoor Aging. E—3 Years Indoor Aging. F—6 Months 95° C. Dry Aging. G—2 Years 95° C. Dry Aging.

Inspection of the data on Zamak 2 and the 4-3 alloy shows that while the magnesium present in the former has delayed the loss of toughness at room temperature during the first 2 years of aging the same low value will be reached in another year or so. In both alloys the loss of toughness is greatly accelerated by increase in temperature.

Zamak 3 is virtually unaffected by aging so far as impact strength is concerned. Zamak 5 and Zamak 6 show excellent retention of impact strength at room temperature but suffer substantial losses at 95°C. Consideration of this latter effect should be given in selecting alloys for uses involving temperatures above room temperature.

It may be pointed out that for certain applications where other specific properties are required the residual impact strength of Zamak 5, for instance, even after 2 years aging, at 95°C. may prove adequate. The value 3.5 foot pounds on a 1/4" x 1/4" section is higher than that of the average cast iron.

Tensile Strength

While tensile strength is usually not the limiting factor in present day applications of zinc die castings, the data are of some interest and have been plotted in Fig. 4.

Zamaks 3, 5 and 6 lose tensile strength slowly during all aging conditions. It may be noted that the loss occurring during the rapid initial aging change is a large proportion of the total change.

Zamak 2, at room temperature, increases in tensile strength during the 3 years of aging covered by the

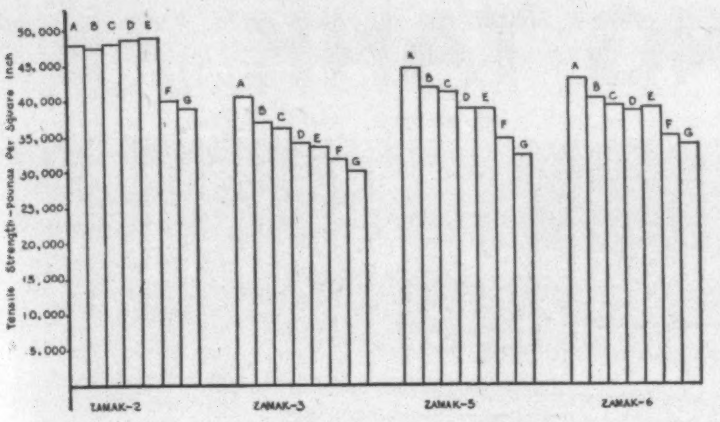

Fig. 4. Effect of Room Temperature and 95° C. Dry Aging on the Tensile Strength of Zinc Die Casting Alloys. A—As Cast. B—5 Weeks at Room Temperature. C—1 Year Indoor Aging. D—2 Years Indoor Aging. E—3 Years Indoor Aging. F—6 Months 95° C. Dry Aging. G—2 Years 95° C. Dry Aging.

present figures. At 95°C. a loss in strength is noted. While it is not known at what temperature the reversal takes place, it is known that at 95°C. a definite trend in the direction of lower strength is developed in a few days.

Tensile Elongation

Interpretation of tensile elongation figures of low numerical value should be approached with due regard for the errors inherent in the measurement. Relatively large deviations in comparison figures may be meaningless. With this in mind inspection of the data in Fig. 5 reveals only one significant effect, namely, that of the serious loss in ductility in Zamak 2 aged at 95°C. Such losses are certain to occur in castings of this alloy subjected to use at temperatures above normal.

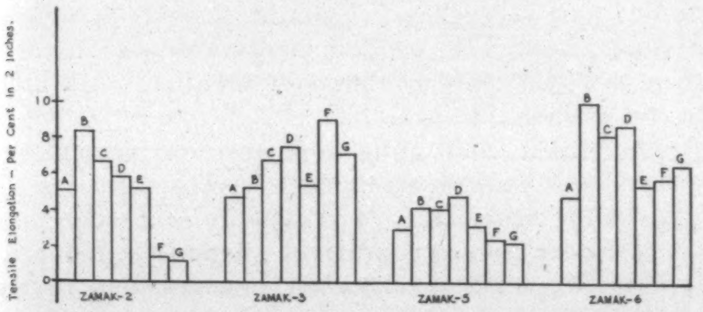

Fig. 5. Effect of Indoor and 95° C. Aging on the Tensile Elongation of Zinc Die Casting Alloys. A—As Cast. B—5 Weeks at Room Temperature. C—1 Year Indoor Aging. D—2 Years Indoor Aging. E—3 Years Indoor Aging. F—6 Months 95° C. Dry Aging. G—2 Years 95° C. Dry Aging.

Brinell Hardness

Indentation hardness tests are of little value in studies of die castings. Since the best available data show a close parallelism between Brinell hardness and tensile strength no further discussion of this property will be made here.

Intergranular Corrosion

Intergranular corrosion is a specialized type of corrosion in which the grain boundaries are selectively attacked. In the present case the corroding medium is moisture. The rate of attack is accelerated by heat as evidenced by the fact that this phenomenon was originally most prevalent in the tropics.

For a number of years, the steam test (an atmosphere saturated with moisture at 95°C.) has been used in the examination of zinc alloys to evaluate their susceptibility to intergranular corrosion. In Figs. 6 to 9 inclusive is shown evidence of the ability of the steam test to differentiate between inferior and superior alloys.

None of the modern alloys shows intergranular attack after 10 days in the 95°C. steam test. Today the test serves its best function as an alternative means of confirming the composition of commercial castings in acceptance tests and has been so adopted by the American Society for Testing Materials.

The impurity contents of the modern zinc alloys have been set at limits which permit no intergranular corrosion to take place in 10 days in the steam test. Failure for any reason to hold the alloy to these limits will be reflected in the results of the steam test. Thus in Figs. 10 and 11 a small addition to the lead content of Zamak 3 has created a definite tendency toward intergranular corrosion.

The interpretation of physical property data obtained from specimens exposed in the steam test is complicated by the fact that the temperature of the test is sufficiently high to accelerate the slow internal aging effects. This is perhaps most clearly shown in Fig. 12.

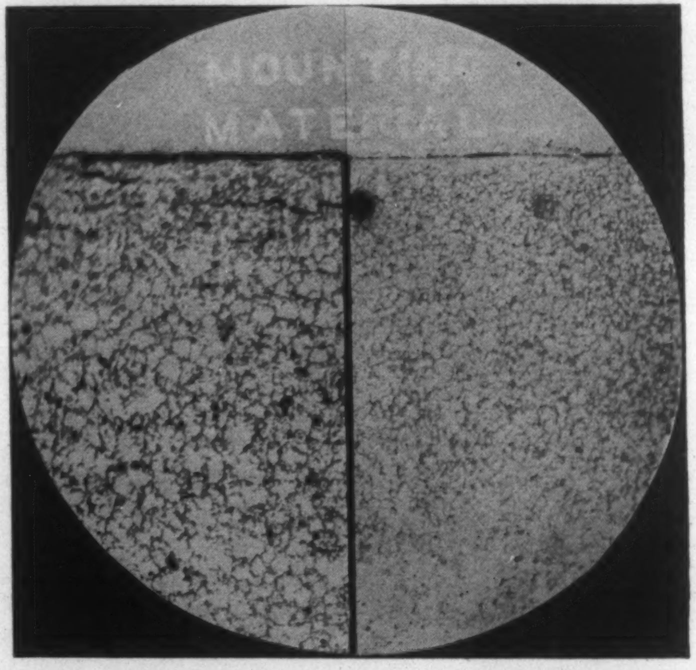

Fig. 6
Alloy containing 4% of Al, 3% of Cu and the balance Zn of 99.95% purity — 10 days in steam test — note intergranular corrosion. Magnification 100X

Fig. 7
Same alloy but exposed 3 years in normal room atmosphere - 75° F.— 50% relative humidity — note intergranular corrosion. Magnification 100X

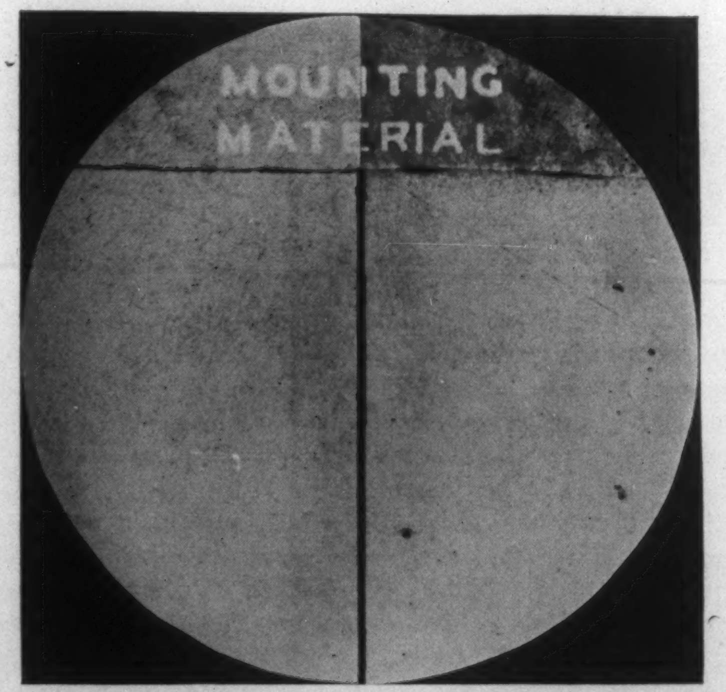

Fig. 8
Zamak 2 after 10 days in steam test — note absence of intergranular corrosion. Magnification 100X

Fig. 9
Zamak 2 after 3 years in normal room atmosphere - 75° F. — 50% relative humidity — note absence of intergranular corrosion. Magnification 100X

The data given in Fig. 12 show how little of the total loss of impact strength of Zamak 2 in the 10-day steam test is attributable to corrosion. What little corrosion is

(Continued on page 102)

THE PICKLING TANK of Tomorrow

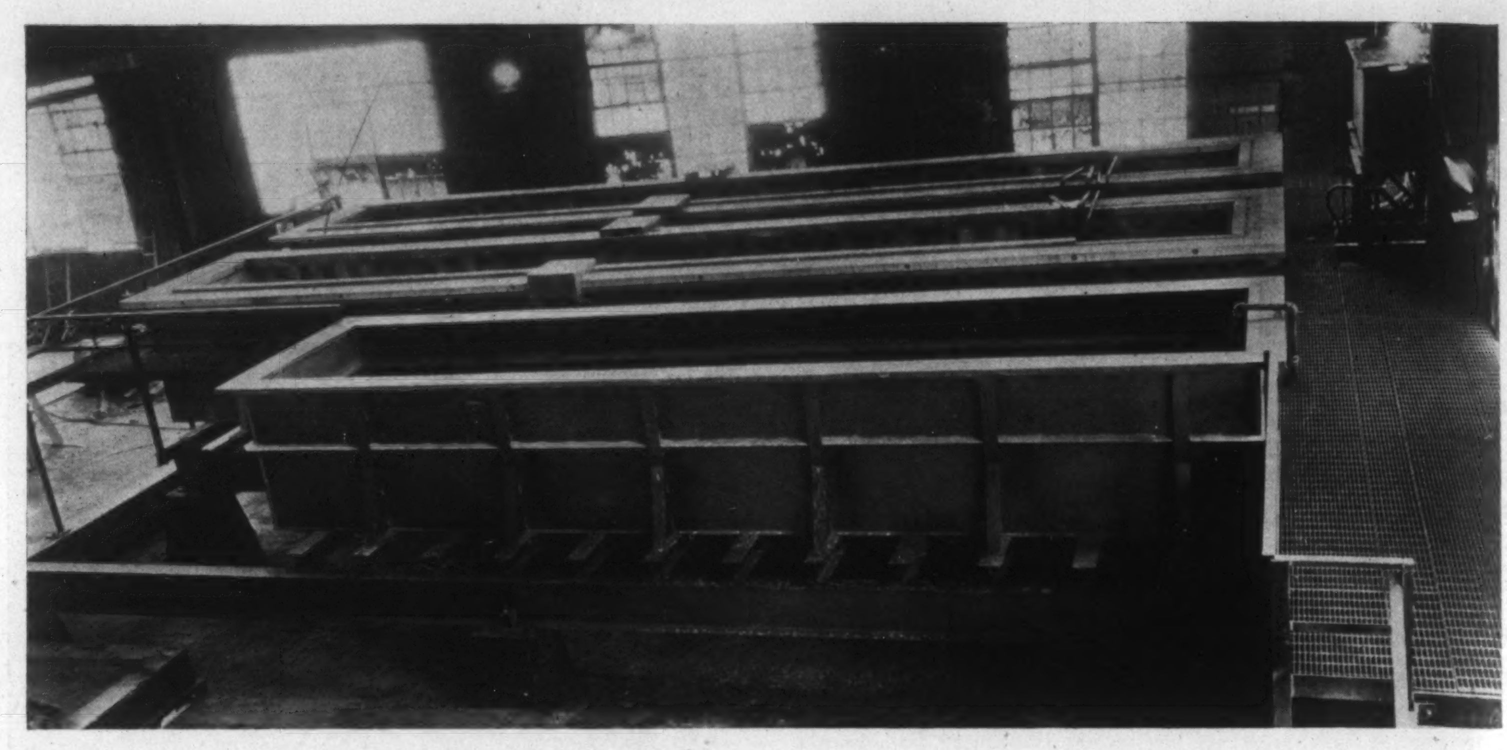

Illustration on this page shows a pickling installation for billets. Two 45 foot Triflex-lined brick-sheathed steel tanks in background. Steel rinse tank in foreground.

By J. R. Hoover*

FOUR years ago, through the coöperative efforts of engineers in several widely different industries, a radically new design of acid pickling tank was introduced. Among expected advantages to be gained were lower pickling costs and improved working conditions.

Engineers and operating men alike expressed justifiable skepticism. Traditionally, acid leakage, frequent shutdowns, high maintenance expense and treacherous wet floors were taken for granted in pickling rooms. Fifty years had not witnessed substantial changes in the design of acid tanks for this work. Numerous ideas had been tried and rejected.

Many steel men had ceased to view with alarm the gross inefficiency of their pickling containers as compared with the progress made in the design of other steel plant equipment; they took it for granted that the cleaning of tonnage steel in hot acid was inherently a job for which reasonably permanent equipment could not be built.

There were others, however, still searching for improvement and glad to coöperate in the development and testing of the new idea. One of these men, a chief engineer of a large steel company, frankly remarked: "When I put in a new acid tub I expect it to start leaking the next day and to continue leaking for the next two or three years, until finally I pull it out and begin over again." But he was not satisfied with such conditions, nor did he take it for granted they could not be bettered. From such men, who recognized the wastes imposed by leaking tubs, and who persisted in the search for improvement, came hearty coöperation and a proving ground for the new type of pickling tank.

Iron and steel men had further reason to be interested. The new tank was fabricated basically from their own product, and if successful would provide a new outlet for steel plate. The welded steel tank was to be lined with a new three-ply rubber and sheathed with brick inside the rubber lining.

Rubber-lined steel tanks were not new in pickling; but most steel men had rejected them because of certain basic faults. In the first place, existing rubber linings were not adapted to the severe conditions encountered. Hard rubber, best in point of chemical permanence, invariably cracked in service owing to the effects of impact or expansion and contraction with changes in temperature.[1] Even flexible or leathery hard rubber compounds, developed in an effort to overcome this limitation, gradually became weak and brittle when subjected to continued service at pickling temperatures. All hard rubber compounds were brittle at freezing temperatures. Cracked hard rubber linings, moreover, were extremely difficult to repair satisfactorily.

Soft rubber readily absorbed the strains incident to expansion and contraction, but was too easily cut and gouged by heavy metal parts. Soft rubber, too, lacked the resistance of hard rubber to oxidation and to the penetration of hot acid, oils and vapor.

A further defect in many of the rubber-lined tanks which had been tried in pickling was poor adhesion between lining and steel. Blisters formed and failure soon followed. Accidental puncture of a poorly adhered lining often permitted acid to creep between lining and steel, causing extensive damage to the tank before the original point of rupture was discovered. (Also a familiar defect in lead-lined tanks.)

All of these were questions of rubber technique, and as such concerned chiefly the rubber manufacturer. Fortunately, the problem of integral adhesion between rubber and steel had already been solved by B. F. Goodrich Co.

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*Assistant Manager, Chemical Sales Division, The B. F. Goodrich Rubber Co., Akron, Ohio.

[1] The co-officient of expansion of rubber within the temperature range 32°-250°F. is approximately 5 times that of steel.

chemists in 1924.[2] In case of accidental puncture, the Vulcalock bond, in itself acidproof, allowed no seepage between lining and steel tank.

With the successful application of the Vulcalock process as a background, Goodrich engineers turned to the job of designing a tank lining which would combine the merits of hard with those of soft rubber and eliminate the apparent weaknesses of each.

The result was Triflex,[3] a distinctly new form of rubber lining, comprising a layer of true hard rubber (ebonite) cushioned between 2 layers of resilient soft rubber, all 3 plies being vulcanized together to form an integral structure. The resistance of hard rubber to chemical and solvent action, diffusion and absorption was combined with the resilience of soft rubber; at the same time yielding a structure of greatly improved resistance to impact, cutting and gouging. Repairs, if necessary, were easily made.

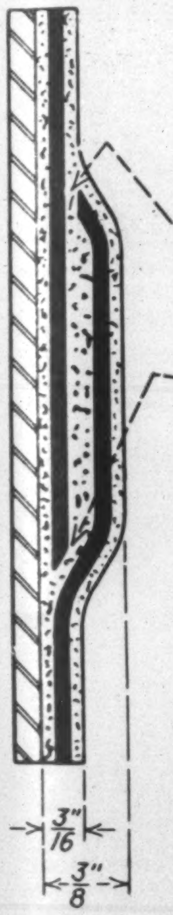


Fig. 1. Triflex Expansion Joint

Note: The hard rubber layers are not joined together. The soft rubber layers allow for expansion and contraction.

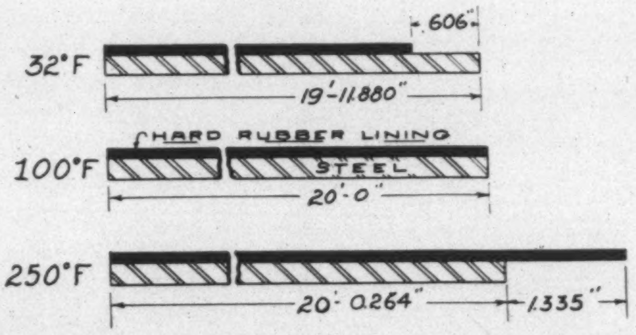


Fig. 2. Relative Expansion of Rubber and Steel. Assume lengths of rubber and steel are the same at 100° F. Note difference in lengths at other temperatures.

Adequate provision was made for expansion and contraction with changes in temperature. The plies of hard rubber in adjacent sheets of Triflex were overlapped in such a manner that they floated in soft rubber, free to come and go without distortion or cracking as heat conditions changed.

Bonded to steel tanks by the Vulcalock process, the new three-ply construction with expansion joints was a fundamental advance in rubber lining. Many of the objections of steel men had been overcome; but serious problems remained to be solved before rubber-lined tanks would again be given important consideration for pickling rooms.

Most vital was the matter of protecting the rubber linings from accidental violent contact with cradles, chains, or the steel being pickled. Brick, because of its known chemical permanence, physical strength and low cost, was the logical material to choose for this part of the structure. Through the coöperation of engineers in the field of ceramics and jointing materials a systematic study of materials and methods was made.

Acid-resisting shale brick of common size, wire cut and well vitrified, were found generally best suited for this work owing to their good adhesion to jointing materials, excellent physical properties and low cost. The strongest, most durable method of jointing appeared to be the Vitrobond process of the Atlas Mineral Products Co.

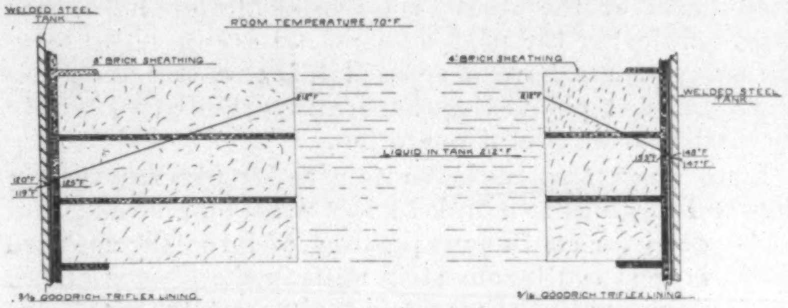
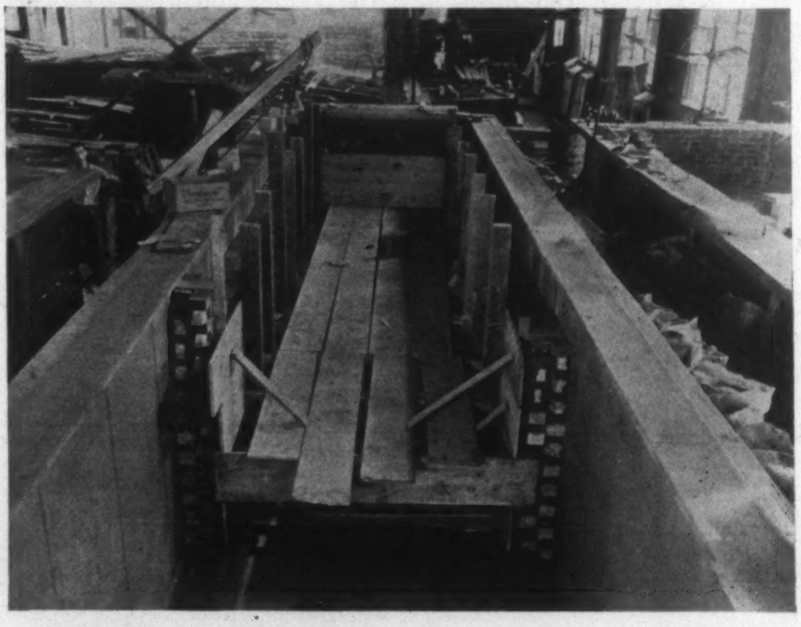


Fig. 3. Temperature Gradient of Brick Sheathed Vulcalock Tanks.



Installing Brick-Vitrobond Sheathing in 45 foot Triflex-lined Steel Tanks for Billet Pickling. (Courtesy The Atlas Mineral Products Company.)

In tanks of more than about 16 feet length this process involved the use of special rubber expansion joints in the brick walls and base, which relieved the completed structure from serious strains due to changes in temperature.

In addition to insuring freedom from mechanical damage to the rubber lining, brick sheathings were found to have the further merit of substantially reducing the temperature at the rubber surface. See Fig. 3. This was of fundamental importance. The insulating effect persisted in spite of small cracks at the joints or seepage through the brick, and served materially to increase the useful life of the rubber lining. Reasonably free circulation of air around the outside of the tank was necessary in order to obtain the maximum reduction in temperature.

The essential features of an acid pickling tank for the steel industry appeared to be combined in the new construction. Installations were made. Data and experience were accumulated. Further details of construction were worked out. Engineering and operating men of the steel industry contributed valuable aid during this stage of the development in establishing the proper design of welded tank and in furnishing a proving ground of actual service. Flange construction, structural reinforcement, methods of support, ledge protection, outlets and syphons—all were studied and designed. Tanks were used, watched and constructively criticized.

After a large sheet pickling tank had been installed in one plant the master mechanic was heard to remark, "Well, that's a fine-looking tank. If she doesn't leak she'll pay for herself in the first year of operation." More and more steel men were coming to the realization that acid losses and the expense of trying to keep tanks tight were very considerable items in the cost of pickling. More important, however, was the growing confidence that such wastes were *avoidable*. The new type tank was being tried and proved.

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[2] The Vulcalock process. U. S. Patent Nos. 1605180-1617588.
[3] Triflex. U. S. Patent No. 1919366.

Practical results speak for themselves. Nearly a hundred tanks of the steel-Triflex-brick design have been installed during the past 4 years. All are in active service today. None have developed leaks or structural defects. In most plants they have earned their cost within the first year or two of operation.

Sizes range from small containers for pickling stampings and forgings to a tank 14 feet wide, 90 feet long and 8 feet deep for continuous pickling of large sheets. Two of the largest continuous strip mills in the United States are equipped with the new acid tanks—a total of 11 sixty-foot tanks in this service. Long, heavy billets are being pickled, 20 tons per load, in 2 forty-five foot tanks of the steel-Triflex-brick construction installed during the summer of 1933.

In every case maintenance work has consisted simply in the periodic application of acid-resisting paint to the exterior. Heat from the bath within keeps the outside steel surface dry, minimizing corrosion.

Steel, rubber and brick, 3 widely different materials of construction, each designed to perform definite functions in the whole tank structure, combine to achieve these results. The anticipated savings are being made. Pickling costs have been substantially reduced, working conditions improved; and a new market for steel has been opened up—objectives gained simply through intelligent cooperation of far-sighted engineers and operating men who refused to be satisfied with wasteful methods.

Steel-Triflex-Brick Tanks used for Pickling in Wire Mill.

Zinc Die Casting Alloy Aging Data

(Continued from page 99)

noted is largely due to surface attack. Similar comparisons may be made with respect to dimensional changes and other of the properties normally measured. In steam test studies of a series of new alloys it is important to know which have low final values because of corrosion and which because of heat.

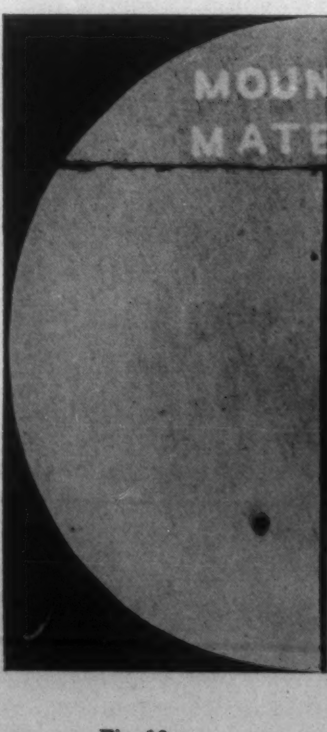

Fig. 10
Zamak 3 (0.004 % Pb) after 10 days in steam test — note absence of intergranular corrosion. Magnification 100X

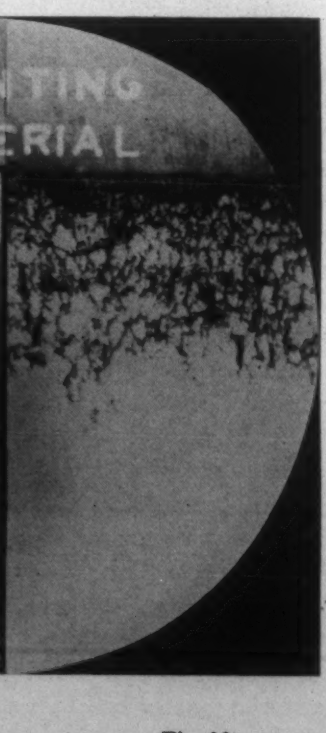

Fig. 11
Zamak 3 (0.009% Pb) after 10 days in steam test—note intergranular corrosion. Magnification 100X

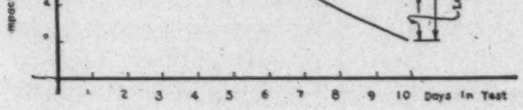

Fig. 12. Effect of 95° C. Dry Heat and Steam on the Impact Strength of Zamak-2.

Résumé

In this article an attempt has been made to explain by means of typical data the tests used in examining zinc die casting alloys to determine their applicability to particular service requirements. It has been shown:

1. That rapid aging changes occur in all of the modern zinc die casting alloys which result in a small shrinkage and an increase in ductility.

2. That indoor aging tests at room temperature must be supplemented by elevated temperature tests when the data are to apply to service at temperature above room temperature.

3. That steam test data must be corrected for effects due to the temperature of the test if the true effects of corrosion are to be determined.

FLUTING in Annealed Sheet Steel and its ELIMINATION

by Wayne A. Sisson* and George L. Clark*

SOME LOTS of annealed soft steel sheets, when given a free bend, bend at a sharp angle instead of in a large smooth arc. The phenomenon of sharp bending is termed "fluting," and fluting sheets are not satisfactory for some forming operations.

The sharp bend or flute seems to be associated with that shape of stress-strain diagram in which after the yield strength is reached, the curve dips downward. The fibers on the outside of the bend, carrying the extreme tensile stress, deform immediately and the maximum stress is transmitted to the next adjacent fibers which in turn deform at once. All the deformation is thus confined to a small area. In the case of a stress-strain diagram lacking the dip, the applied stress is distributed over a greater area, since the fibers at maximum stress yield slowly.

It is well known that soft steel in a strained condition, or one that has had a small amount of cold work (and has not been aged or heated) has a stress-strain diagram smoothly curving at the yield strength, without a sharp dip. Such material bends over a large radius, i.e., does not flute.

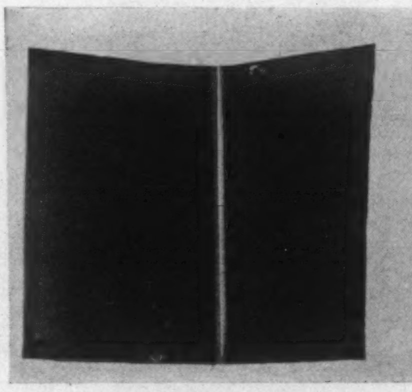

Fig. 1a. Small sharp arc characteristic of fluting Sheet

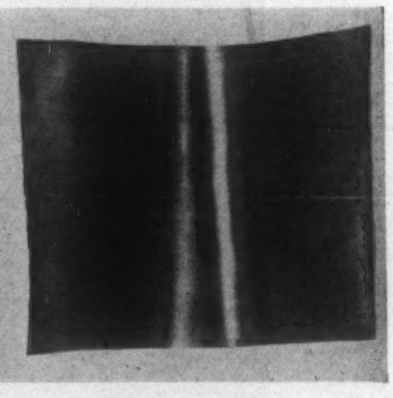

Fig. 1b. Large smooth arc characteristic of non- fluting sheet

Tamman† states that yielding just beyond the elastic limit, in materials showing a dip in the stress-strain diagram, is not merely along the glide planes of the crystals, but involves displacement of the crystals with respect to one another. On this basis, grain size should have an effect upon fluting.

It is known that a small amount of cold work will eliminate fluting and also that quenching from below the critical will prevent it. Experiments were carried out to determine the amount of cold work required, the proper quenching temperature, effect of reduction prior to annealing, effect of grain size, etc. Fluting was determined by bending and noting whether a sharp or a rounded bend resulted.

The material used was open hearth strip analyzing approximately 0.08% C, 0.4% Mn, 0.012% P and 0.04% S, which had been hot rolled to 0.08″, pickled and cold-rolled without intermediate anneals to 0.01″, i.e., an 87.5% reduction.

Two series of quenching tests were made, the results of which are shown in Table 1.

It will be noted that all air cooled specimens fluted, that quenching from 650°C. (1200°F.) or below was ineffective, and did not materially alter the hardness, cupping or bend test results from those shown on specimens air cooled from the same temperature. On quenching from 700°C. (1290°F.) or higher, fluting was eliminated, but the steel was harder and less ductile after quenching than after air cooling. Thus the quenching method of avoiding fluting involves a material change of properties.

That the quenching temperature rather than the temperature to which the sheet is heated is the important variable was established by heating to 800°C. (1470°F.) and cooling in the furnace, removing and quenching specimens at 50°C. intervals. Those quenched from below 700°C. (1290°F.) fluted, those quenched above it did not. More rapid cooling in a current of air or by contact with a cold metal surface did not prevent fluting, actual quenching was required.

Since these tests were made on severely cold-rolled material, a series of tests was run to find if less severely cold-worked material required quenching. Steel similar to that used above, but in hot-rolled strip 0.05″ thick was cold-rolled in 15 steps, giving samples with reductions ranging from 8 to 80%.

Duplicate samples at each reduction were heated at 750°C. (1382°F.) for 30 minutes, one set air cooled, the other water quenched. *No* quenched sample showed fluting.

Table 1

Anneal °C.	Temp. °F.	Treatment	Rockwell[1] Numbers	Olson[2] Cup	No.[3] Bends	Remarks
		(Time of annealing 30 min.)				
500	932	Air cooled	95.6	1.20	5.8	Fluting
500	932	Quenched	96.8	1.10	6	Fluting
580	1075	Air cooled	79.2	2.80	11.4	Fluting
580	1075	Quenched	82	2.70	11.2	Fluting
650	1200	Air cooled	86.6	2.50	8.9	Fluting
650	1200	Quenched	91.8	2.30	8.6	Fluting
700	1290	Air cooled	86	2.55	9.4	Fluting
700	1290	Quenched	94.2	2.15	6	No fluting
750	1380	Air cooled	79.4	2.70	10.8	Fluting
750	1380	Quenched	96.6	2.15	5.2	No fluting
870	1595	Air cooled	84	2.60	11.4	Fluting
870	1595	Quenched	95	1.85	4.5	No fluting
		(Time of annealing 5 min.)				
650	1200	Air cooled	83	2.65	8.4	Fluting
650	1200	Quenched	87	2.50	5	Fluting
700	1290	Air cooled	82	2.70	8.4	Fluting
700	1290	Quenched	98	2.17	4	No fluting
750	1380	Air cooled	81	2.70	8	Fluting
750	1380	Quenched	97	2.10	4	No fluting
800	1470	Air cooled	84	2.65	8.6	Fluting
800	1470	Quenched	98	2.20	4.8	No fluting
850	1560	Air cooled	84	2.65	9.8	Fluting
850	1560	Quenched	99	2.00	3.4	No fluting
900	1650	Air cooled	83	2.70	10	Fluting
900	1650	Quenched	100	2.25	3.8	No fluting

[1] Average of 5. [2] Average of 2.
[3] Average of 5. Bends made through 90° by pliers and returned to original straight position.

In the air cooled specimens, no fluting, or only a scarcely detectable tendency toward it, occurred at reductions up to 34% (0.05″ to 0.033″). The samples of 8 to 34% reduction showed larger grain size and were, of course, softer than those with larger reduction. At 42% reduction, definite signs of fluting appeared; at 48%, it was still more marked; and at 52% and above, all samples were badly fluted.

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*Department of Chemistry, University of Illinois.

†G. Tamman. A Text Book of Metallography. 3rd Edition. Chemical Catalog Company, 1925, page 86.

Apparently, fluting is less severe in air cooled specimens below 40% reduction. To make sure that this was not due to testing thicker samples, some thick sheets were tested and it was established that fluting occurs on thick sheets that have had over 40% reduction, though of course, the bend is not as sharp as it is on thin stock.

The question arose whether a sheet once made non-fluting by quenching would stand high cold reduction and air cooling after annealing. Non-fluting (quenched) material was cold-rolled 65%, heated to 700° C. (1290° F.) and air cooled, then showing fluting. Quenched, non-fluting material, not thereafter cold-rolled was heated to 600°C. (1110° F.) and air cooled, but it fluted. Thus, the non-fluting property is lost by these treatments that restore the stress-strain diagram to the type with a sharp dip.

Moreover, it was shown that the same specimen could be made fluting by air cooling and non-fluting by quenching from 700°C. (1290°F.) no matter whether it had previously been in the opposite condition, i.e., the process of making a fluting or non-fluting specimen is reversible. Thus, the past thermal history of the sheet is not a determining factor, the things that count are the quenching temperature and rate of cooling.

Microscopic examinations showed no detectable difference between air-cooled and quenched specimens, unless, of course, the quenching temperature was raised above the transformation temperature. X-ray examination of a fluting sheet at the bend showed nothing save slight evidence of deformation. Fluting specimens bent and heated showed no marked increase in grain size, i.e., no evidence of critical deformation.

As stated above, it is well known that fluting may be eliminated by a light or "skin" pass. The samples of Table 1, (5 min. anneal) that had been air cooled from temperatures ranging from 650°C. (1200°F.) to 900°C. (1650°F.) were rolled in a small hand mill till fluting disappeared. A reduction of 1.9% was required on the specimens annealed at the lowest temperature, one of 1.1% on those annealed at the highest temperature, with intermediate reductions at intermediate temperatures.

The series of samples that had been cold-rolled from 0.05″ hot strip with reductions varying from 8 to 80% was annealed at 650°C. (1200°F.) and air cooled. As before, those samples of reductions from 8 to 34% showed no fluting. Those from 42 to 80% reduction required about 1 to 2%, averaging 1½% reduction to make them non-fluting. Thus, the reduction prior to annealing does not affect the reduction after annealing necessary to prevent fluting. The slight cold reduction required does not appreciably affect the Rockwell hardness or the resistance to repeated bending.

So far, we see that either a skin pass, or quenching from above 700°C. (1290°F.) will prevent fluting. The quenching operation requires that the sheet enter the water perpendicularly, for if it cools irregularly, warping results. It was noted that quenched sheets rust more quickly than air cooled sheets, possibly because of local strained areas, which is a further drawback to the quenching method. Quenching produces a sheet of higher hardness, poorer forming ability, a tendency to warp and smaller resistance to repeated bending.

The observation that material cold rolled something less than 40% before annealing did not show fluting on air cooling, and that these had a larger grain size than those similarly treated but more severely reduced before annealing, opens up the possibility of avoiding fluting by producing a sheet of large grain size. Of course, too large a grain size would lead to other difficulties, such as the "orange peel" effect, but an optimum grain size might be found. The logical way to control the grain size would be to reduce from the hot rolled strip nearly to final thickness by severe reduction, anneal, give a final small reduction and second anneal.

Samples of the material .01″ thick with a 87.5% reduction mentioned in the first part of this paper were annealed at 750°C. (1380°F.) and given various small percent reductions. This was followed by annealing the various samples as 3 different temperatures. These were tested for fluting. A summary of the treatments and results is given in Table 2.

These data indicate that when annealed at 885°C. (1620°F.) the best results are obtained between 6 and 25% reduction and when annealed at 700°C. (1290°F.) between 7 and 19% reduction. Annealing at 640°C. (1185°F.) does not appear to give as satisfactory results as at the higher temperatures. However, the best results were found between 13 and 25% reduction.

Samples of the 0.05″ material reduced from 40 to 80% were annealed

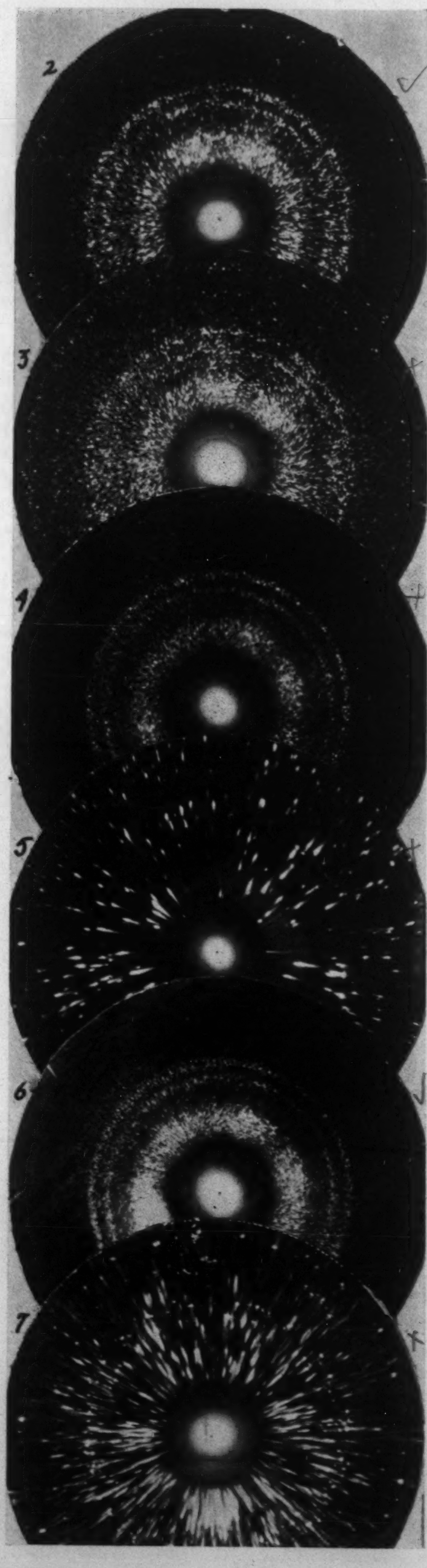

Fig. 2. X-ray pattern of sample rolled 87.5%, heated at 750°C.: and allowed to cool slowly. Fluting present.

Fig. 3. Sample treated same as Fig. 2 but water quenched. Fluting absent.

Fig. 4. X-ray pattern of same material as Fig. 2 after a slight rolling of 1.5% to eliminate fluting.

Fig. 5. Sample rolled from 0.08″ to 0.012″, annealed at 750°C., then rolled to 0.01″ and given a final anneal at 750°C. Fluting absent.

Fig. 6. X-ray pattern of commercial sample of tin plate which shows fluting.

Fig. 7. Commercial sample of tin plate with fluting absent.

Table 2

Percent Reduction	Anneal Temp. °C.	°F.	Results	Remarks*
		(Time of annealing—15 minutes)		
3.6	640	1185	Fluting	Small grains
5.5	700	1290	Slight fluting	Large grains
6.4	640	1185	Slight fluting	Medium grains
6.4	885	1620	No fluting	Large grains
7.3	700	1290	No fluting	Large grains
9.0	640	1185	Some fluting	Medium grains
9.0	885	1620	Slight fluting	Medium grains
10.0	700	1290	No fluting	Large grains
13.6	640	1185	Some fluting	Medium grains
13.6	885	1620	No fluting	Medium grains
14.5	700	1290	No fluting	Large grains
19.0	700	1290	Slight fluting	Medium grains
21.0	640	1185	Some fluting	Smaller grains
21.0	885	1620	No fluting	Large grains
23.5	700	1290	Some fluting	Smaller grains
25.5	640	1185	Little fluting	Large grains
25.5	885	1620	Some fluting	Smaller grains

*All estimates of grain size were made from x-ray diffraction patterns and from a qualitative microscopic examination.

Table 3

Percent Reduction First	Second	Anneal Temp. °C.	°F.	Results	
		(Annealing time—5 minutes)			
42	8.9	710	1310	Some fluting	Small grains
48	17.7	600	1110	Some fluting	Medium grains
52	7.7	775	1427	No fluting	Large grains
58	26.0	700	1290	Slight fluting	Large grains
62	23.0	710	1310	Slight fluting	Large grains
66	12.0	600	1110	Slight fluting	Large grains
68	11.3	710	1310	Slight fluting	Large grains
72	24.0	600	1110	Slight fluting	Large grains
75	9.0	775	1427	Slight fluting	Large grains
78	15.0	770	1415	Slight fluting	Large grains
80	12.0	775	1427	No fluting	Large grains

Table 4

Anneal Temp. First °C.	°F.	Second °C.	°F.	Percent Reduction	Results	
		(Time of Annealing—5 minutes)				
740	1365	750	1380	13.7	No fluting	Large grains
740	1365	700	1290	13.7	No fluting	Large grains
740	1365	750	1380	9.9	No fluting	Large grains
740	1365	700	1290	9.9	No fluting	Large grains
800	1470	750	1380	11.8	No fluting	Large grains
800	1470	700	1290	11.8	No fluting	Large grains
800	1470	750	1380	8.5	No fluting	Large grains
800	1470	700	1290	8.5	No fluting	Large grains

at 750°C. (1380°F.), given a small further reduction and annealed and tested for fluting. A summary of results is included in Table 3.

These results give very little additional information except the fact that the percent reduction before the first anneal is not as important in determining the grain size as the reduction before the last anneal.

In order to further check the method of eliminating fluting by regulating the grain size, the following tests were made on .01″ steel reduced 87.5%. A summary is given in Table 4.

These results demonstrate the fact that fluting can be eliminated with consistent results over a fairly wide range of percent reductions and temperature of annealing.

An unsuccessful attempt was made to produce large enough grains to eliminate fluting by heating the sample to 910°C. (1670°F.) and allowing it to cool slowly through the transformation range.

Two samples of tin plate, one of them showing fluting and the other no fluting, were examined and X-ray patterns taken. These show that the non-fluting sample has much larger grains than the fluting sample.

Hardness and bend tests of sheets treated by the above method show that sheets having large grains are very soft. They show as satisfactory bending tests as material treated by other methods. The strips are very flexible and easily bent and do not show as great a rigidity as sheets treated by other methods. However, the radius of the bends obtained on sheets treated by this method is not as large as that on sheets treated by the other methods.

We have shown above that fluting may be eliminated by giving the hot rolled strip a large reduction, followed by annealing; then a small reduction followed by a final anneal. As yet we do not know the exact limits of the grain size or the reductions and temperatures of annealing which may be used for this process.

The next step in the investigation would be to make a quantitative study of the relationship between percent reduction and annealing temperature and the grain size, tendency to flute and physical properties of sheets having a definite chemical analysis.

From available data we see that the final temperature of annealing should be above 700°C. (1290°F.) and that the softest material is obtained between a final reduction of 5 and 25%.

We would judge the best procedure, when starting with .08″ hot rolled strip, would be to reduce to .012″, anneal approximately at 750°C. (1380°F.) then reduce to .01″ and give it a final anneal at 750° to 800°C. (1380° to 1470°F.). This should give a sheet with large grains, low Rockwell hardness and free from fluting, if results obtained on a small scale can be duplicated on a large scale.

The above results have been obtained on small specimens of low carbon steel. The effect of percent carbon and other elements, such as phosphorus, sulphur, silicon and manganese, is unknown and different results may be obtained on samples of a different chemical analysis. It is also to be recognized that it is possible that the results obtained here may not be duplicated when repeated on a larger scale or under different conditions.

Besides the well known methods of eliminating fluting, use of a "skin" pass, which does not materially alter the physical properties or the forming ability, or quenching from above 700°C. (1290°F.), which lowers forming ability and hardens the material, it thus appears that a third method, production of controlled (large) grain size by giving a large reduction, an anneal, a very small reduction and a final anneal, which does not reduce formability, but instead gives the softest product, may be at least as satisfactory and probably superior for some purposes to the other methods.

Rapid Determination of Oxide in Molten Steel

(Continued from page 96)

avoid loss of the very fine particles. Following the ignition the platinum dish is cooled in water. This entire operation should take approximately 2 minutes. The ignited alumina is transferred to the balance pan and weighed. It has been found that each weighing may be carried out in ½ minute or less. The oxygen is calculated directly from the alumina.

It will be seen from the above description that the total time for the operation will be less than 10 minutes. In order to check the accuracy of the results obtainable by this method, samples have been analyzed by the standard alumina method as previously described by Cunningham and Price.[3] Typical results on samples of low and high carbon and variable oxygen steels follow.

Sample	*C*	*Oxygen* *Standard Method*	*Union Carbide Method*
1	.20	.029	.028
2	.91	.050	.050
		.048	.048
3	.02	.192	.190

This method is thus shown to be sufficiently accurate and sufficiently rapid so that it should be of direct use in determining oxygen content of the steel during the course of the heat.

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[3] Cunningham & Price. *Industrial & Engineering Chemistry, Analytical Edition,* Vol. 5, 1933, page 27.

Dimensional Changes in

DIE CASTING ALLOYS

Metastable Beta Phase in Aluminum-Zinc Alloys**

by R. G. Kennedy, Jr.*

I. Introduction

The study of the mechanism of the decomposition of unstable alloy phases is of considerable practical and scientific importance to metallurgists. The present investigation was undertaken as a first step toward the goal of a more complete knowledge of unstable phases, and deals with an outstanding example of spontaneous decomposition at ordinary room temperature—the β phase of the aluminum-zinc alloy system.

Previous investigations of the aluminum-zinc system including those of Rosenhain and Archbutt,[1] Bauer and Vogel,[2] Hammi,[3] Hanson and Gayler,[4] Pierce,[5] Fraenkel,[6] Tanabe[7] and others have contributed to the sum total of our knowledge of this important binary system. Of these, however, Hanson and Gayler, Fraenkel and Tanabe are to be credited for most of the information available on the peculiar behavior of the β constituent, which corresponds with the compound Al_2Zn_3 and is stable only above 256°C., and which is the unstable phase examined in this work.

In previous investigations some discrepancies have been observed in the various recorded periods required for the decomposition of this β phase. Slight amounts of impurities in the constituent metals may have caused these discrepancies. Hence, in this work care was taken to eliminate effects due to impurities by using very pure metals in making up the alloys. The effect of the deliberate addition of small amounts of magnesium on the decomposition of the unstable β phase was studied also.

II. Materials

Table I indicates the extremely high purity of the metals used in making the alloys. Since there are many examples of alloys in which small amounts of impurities greatly affect the properties of the alloys, it was considered of vital importance in this work to use the purest Al and Zn obtainable. In this way, the characteristic behavior of the β phase would not be obscured by the effects of the impurities, and, when small additions of other metals were purposely made the effects on the properties of the β phase could be catalogued with a high degree of assurance.

ONE of the outstanding metallurgical developments of recent years has been the determination of methods to insure permanence of size, shape, and properties in zinc base die castings. This has been accomplished by adequate control of the quantities of certain elements that affect the transition of the metastable phase in zinc aluminum alloys with the resulting dimensional changes and also control the subsequent inter-crystalline oxidation. Freedom from detrimental changes is insured by the use of high purity zinc with small additions of magnesium to the alloy. However, the mechanism of the structural changes taking place in these alloys is not clearly known and any investigation such as the accompanying article is most welcome to die casting metallurgists. It is fortunate that the desired physical properties are obtained in chill cast zinc base die castings using as little as 4% aluminum, since the amount of metastable beta in such an alloy is relatively small.

Experiments conducted under carefully controlled conditions indicate that a stable zinc aluminum die casting alloy may be produced from 99.99% zinc without any magnesium addition. However, the likelihood of contamination in alloying and casting is so great that the use of a small amount of magnesium in all zinc base die casting alloys is recommended.

Committee B6 of the American Society for Testing Materials on "Die Cast Metals and Alloys" has standardized and published specifications for both an aluminum copper zinc alloy (No. XXI) and an aluminum zinc alloy (No. XXIII) with small additions of magnesium in each case. These alloys have been shown by extensive tests under severely corrosive conditions to be relatively free from disintegration or intercrystalline oxidation when made from zinc of sufficiently high purity and not contaminated with lead, cadmium or tin in alloying or casting.—H. A. ANDERSON.

Table 1. Composition of Metals Used in Preparing the Alloy.

Material	% Si	% Fe	% Cu
*Aluminum	0.007	0.008	0.005
**Zinc, total impurities less than .0001%			

*Furnished by the Aluminum Company of America.
**Furnished by the New Jersey Zinc Company.

In preparing each of the alloys the necessary amount of Al was first melted in a clean graphite crucible in a high-frequency induction furnace and then the required amount of Zn added. After thorough stirring with a graphite rod, the alloy was cast into a split graphite mold. The small oblong ingot in most cases weighed around 400 grams.

These ingots were then given an annealing treatment for 13 days at a temperature of 350°C. in order to obtain homogeniety of structure. The compositions of the alloys are shown in Table 2.

In Fig. 1, which represents Hanson and Gayler's equilibrium diagram, with Pierce's modification of the Zn-rich solid solution boundary, are shown the compositions of a number of β alloys which were prepared and the temperatures from which they were quenched in order to retain them in the β state at room temperature. (The figure also shows 70, 35 and 10% Zn alloys which were prepared for examination by the X-ray powder method in order to compare their crystal structures.) The Zn content of β alloys studied was held within close limits, 77.6 to 78.3%, and consequently, the alloys exhibited to fullest extent the unstable properties attributed to this phase.

Table 2. Composition of the Alloys, 1st Series.

Specimen Designation	% Zn	.% Al	Remarks
Z	78.3	21.7	by chemical analysis
A	85.	15.	nominal composition

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**Publication Approved by the Director of the Bureau of Standards of the U. S. Department of Commerce.

III. Properties of the Metastable Beta Phase

A study was first made of the properties of the alloys along the lines used by previous investigators in order to determine the characteristic properties of the β phase and the change in properties which accompanied the decomposition of this phase.

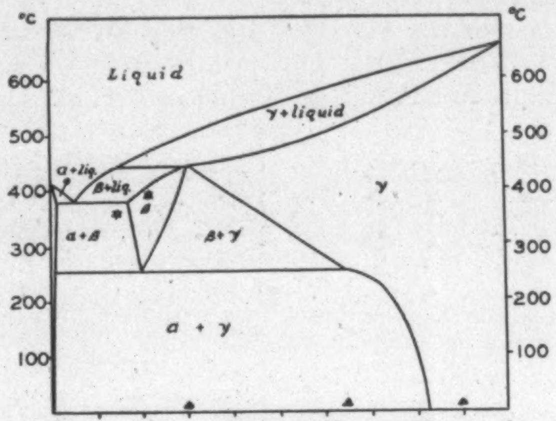

Fig. 1. Zinc-aluminum constitutional diagram

The triangles indicate the compositions of the alloys examined by the X-ray method. The stars indicate the compositions and quenching temperatures of the alloys composed mostly of the β phase, which were extensively studied.

1. Thermal Behavior—Small blocks (1″ x 1″ x ¾″) were cut from ingots Z and A (Table 2). A small hole was drilled to the center of each specimen to accommodate a thermocouple. Each specimen was then heated to 350°C., held there for ½ hour, and quenched in ice water. The thermocouple was immediately inserted into the hole, the specimen wrapped in a cloth, and temperature readings taken. Fig. 2 shows the time-temperature curves for specimens A and Z. Both specimens evolved heat on standing, as has been observed by previous investigators. The evolution of heat after quenching was the greater in specimen Z. This observation substantiates the view that alloy Z consisted entirely of the unstable β phase, above 256°C., whereas specimen A consisted of a mixture of β and another phase. It is also noteworthy that the maximum heat evolution in specimen Z occurred 4 minutes after quenching, which interval agrees fairly well with Hanson and Gayler's results,[4] shown in Fig. 3, except that, on account of the greater purity of the constituent metals of the alloys used in the present case, the reaction proceeded with slightly greater velocity. This phenomenon is important and will be discussed later. Considering the results plotted in Figs. 2 and 3 it appears that when the percentage of the β phase in the quenched alloy was somewhat less than 100%, a faster evolution of heat resulted; thus the maximum heat evolution for the alloys containing 78 to 80% Zn occurred about 5 minutes after quenching, whereas the maximum heat evolution for an alloy containing about 81% Zn occurred about 3½ minutes after quenching and for the 85% Zn alloy about 1½ minutes after quenching. These data indicate that the rate of decomposition of the β phase into the 2 solid solutions, α and γ (Fig. 1), depends upon the presence of a second phase in the quenched alloy, assumed in this case to be an excess of the α solid solution (which persisted in spite of the quenching). Fraenkel and Goez[6] found from dilatometric studies that the decomposition of alloys containing about 78% Zn proceeded as a monomolecular reaction according to the equation:

$$\frac{dx}{dt} = k\ (a-x) \text{ where}$$

t = time after quenching
a = total volume decrease
x = volume decrease up to time, t
(a-x) = amount of unchanged material or of the volume not yet decreased
k = a constant

This equation shows that the rate of contraction $\left(\frac{dx}{dt}\right)$ is proportional to the amount of material (or of volume) yet unchanged (a-x).

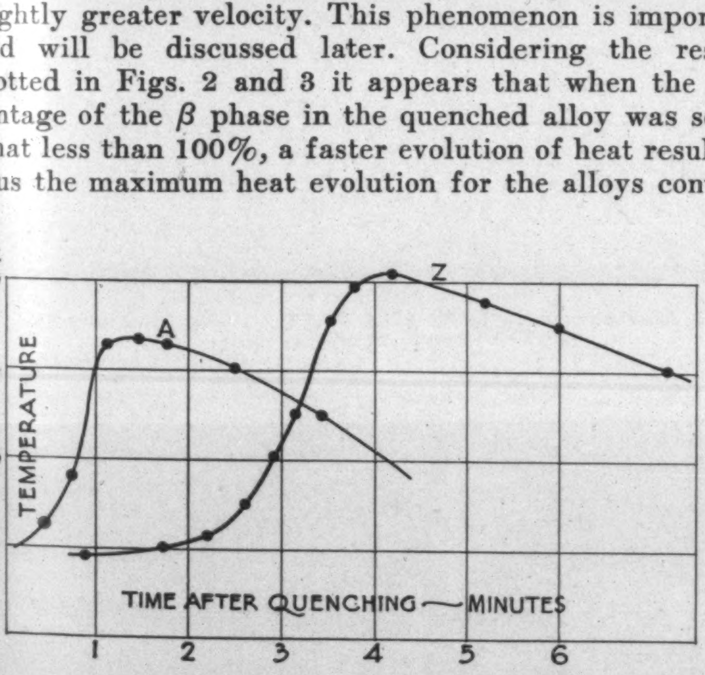

Fig. 2. Time-temperature curves for β phase alloys
A is alloy containing 85% Zn. Z is alloy containing 78.3% Zn.

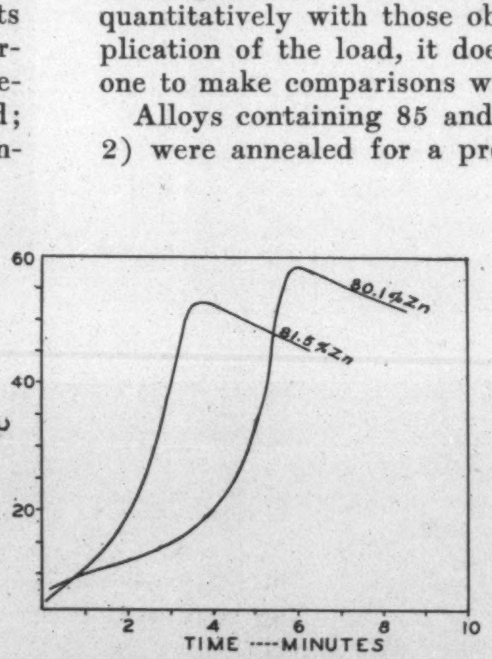

Fig. 3. Time-temperature curves of 2 Al-Zn alloys according to Hanson and Gayler

However, the constant k in this equation is affected by the presence of the second phase (excess α), since the evidence of Figs. 2, 3, 4, 10† and 15† shows that the reaction proceeds more rapidly when the amount of the second phase is initially greater.

2. Age Hardening—As an indication of the physical changes in the alloys, of which the evolution of heat is only one manifestation, the hardness of the alloys was measured as a function of the time after quenching.

Most of the hardness measurements were taken on the "Baby Brinell" machine which uses a 1/16 inch ball and a dead-weight load of 12.6 kg. Such an arrangement corresponds to the ratio of load and area of indentation obtained with a 500 kg. load and a 10 mm. ball. Since the readings tended to "drift" because of the softness of the alloys, the load was applied for only 10 seconds. Although such a method does not give values comparable quantitatively with those obtained with a 30-second application of the load, it does yield results which enable one to make comparisons with successive readings.

Alloys containing 85 and 78.3% Zn (A and Z, Table 2) were annealed for a prolonged period at 350°C. to obtain uniformity of composition, and were then reheated to 360°C. for ½ hour and quenched in ice water. The hardness of the alloys was measured immediately after quenching and at short intervals for some time after they had been quenched. The results obtained with the specimens which were allowed to age in air after quenching are plotted in Fig. 4. As is evident from the curves, the hardness attained a maximum value 6 minutes after quenching in the case of the 78.3% Zn alloy (Z) and in 2 minutes in the case of the 85% Zn alloy (A). The alloys decreased in hardness after the maximum had been reached. A comparison of Figs. 2 and 4 reveals a marked similarity between the curves representing rate of heat evolution and rate of hardening and the generally accepted view that the increase of hardness is a direct result of the decomposition of the β constituent, with the formation of an extremely fine duplex structure replacing one of relatively large crystals, would seem to be verified. As is shown in the following section, microscopic examination of the alloy during the process of decomposition fully justified this assumption.

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†Figs. 10 and 15 will appear in the next installment which will be published in June.

3. Structural Changes—a. Microscopic Examination—A specimen of the alloy containing the 78.3% Zn (Z, Table 2) was polished and then heated to 350°C. for 20 minutes and quenched in iced brine. Water attacks this alloy fairly rapidly with evolution of hydrogen and this corrosive action tends to mar the polished surface. Hence, the specimen was given a quick polish after quenching, etched and examined as soon as possible ($1^1/_3$ minutes after quenching). Other samples of this alloy were etched 2½, 4 and 8 minutes after quenching. The corresponding microstructures are shown in Figs. 5 and 6. Figs. 5 and 6A show homogeneous grains of the β phase. In Fig. 6A, however, small dark spots can be seen within the large β grain which evidently is the first indication of the decomposition of β into the finely divided duplex structure consisting of the α and γ solid solutions. Fig. 6B of the specimen etched 2½ minutes after quenching shows the decomposition of the β phase had progressed almost entirely throughout the specimen, and Fig. 6C shows only a small amount of unchanged β (white areas) 4 minutes after quenching. In Fig. 6D (8 minutes after quenching) is seen an extremely fine grained uniform structure with a few very small white dots presumably indicating traces of the unchanged β phase. The series of micrographs constitute a graphic picture of the decomposition of the large crystals of β phase into the fine eutectoid structure of $\alpha + \gamma$ solid solutions, and, thus, the rapid increase in hardness of this alloy during the change in the β phase can be partly explained.

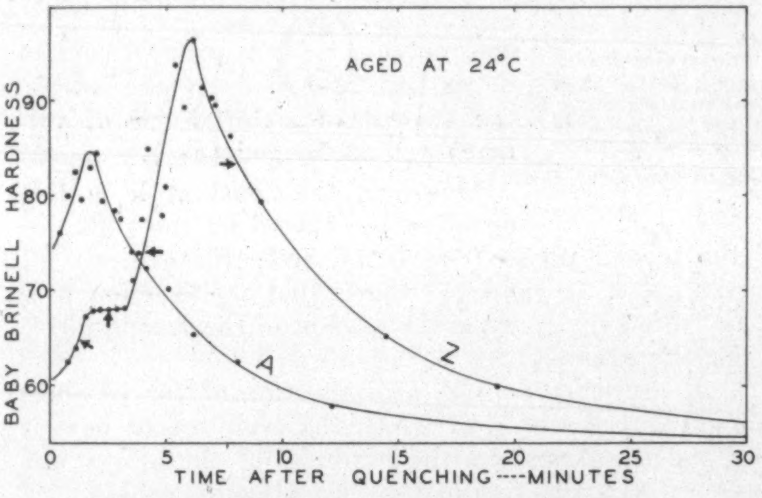

Fig. 4. Time-hardness curves for β phase alloys

The microstructure of the 78.3% Zn alloy Z at the various stages of decomposition as indicated by the arrows can be seen in Fig. 6.

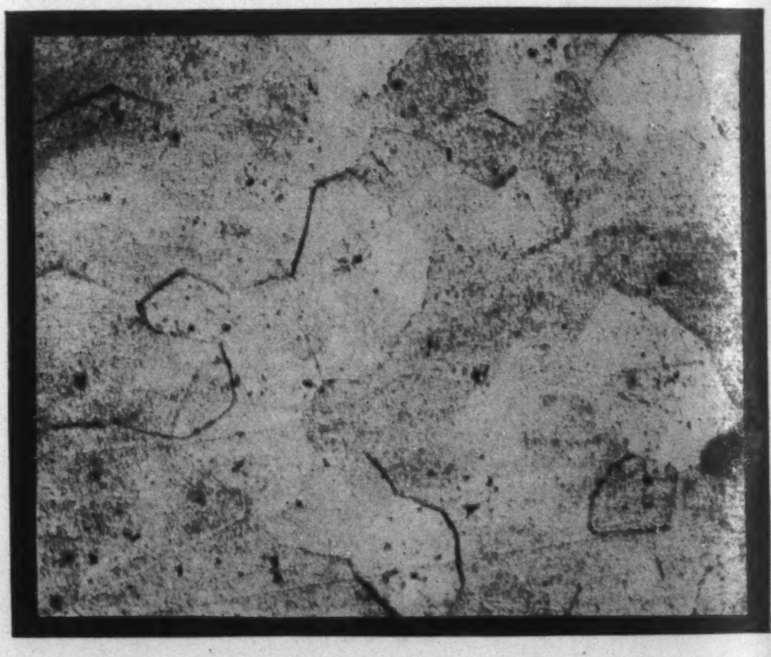

Fig. 5. Microstructure (100 X) of the 78.3 % Zn alloy (Specimen Z) Etched 1 minute after quenching

b. X-Ray Examination—X-ray spectrograms were taken of all specimens using molybdenum radiation. A small ingot of a Zn-Al alloy (78.3% Zn) was melted in the high frequency furnace and cast in a split graphite mold. A sample from the center of the ingot was swaged down to wire of 0.6 mm. diameter. The X-ray pattern of this wire was splotchy and not easily measured. However, the sample was filed, the filings annealed in vacuo, placed in a glass capillary tube, and an X-ray pattern taken of the sample at room temperature. A fine tungsten wire was then run through the center of the filings, the

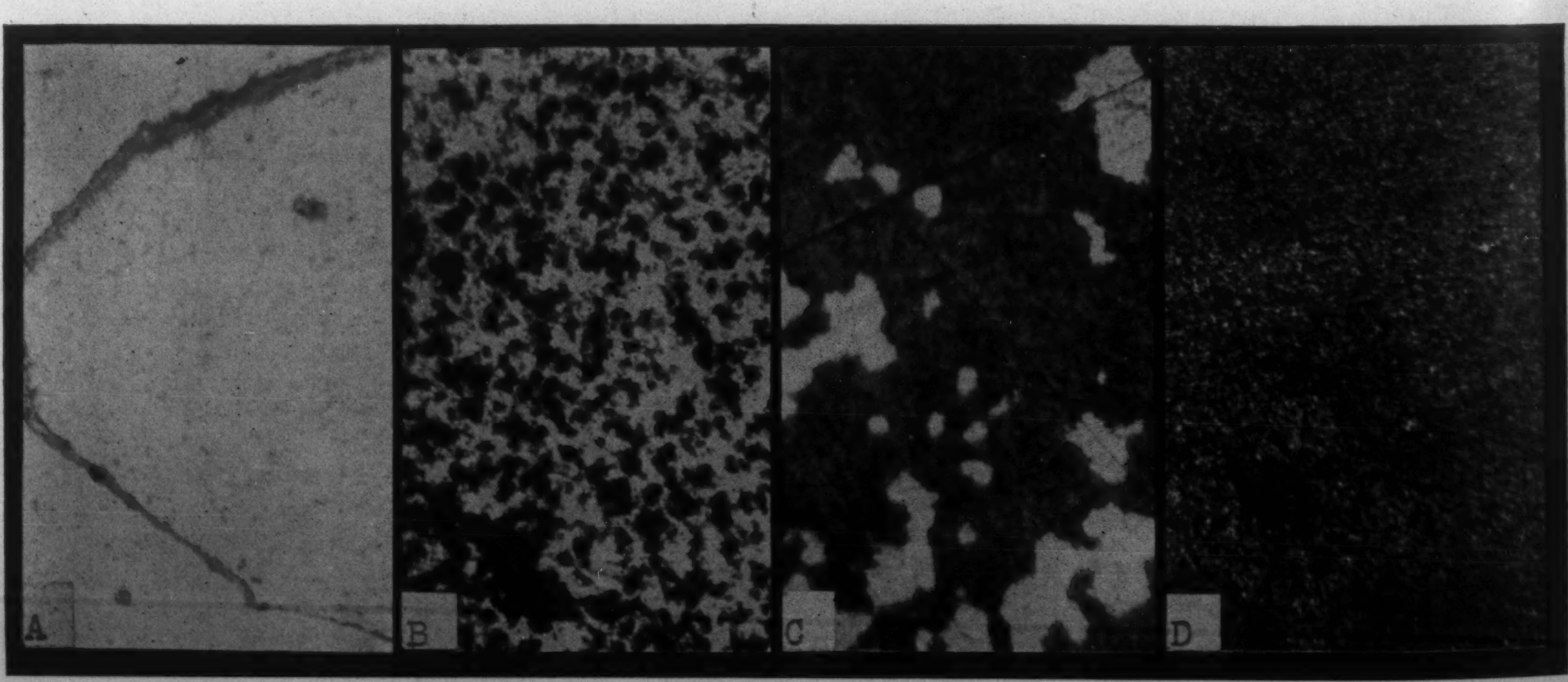

Fig. 6. Microstructures (600 x) of the various stages of decomposition of the β phase alloy (Specimen Z)

A—etched 1⅓ minutes after quenching.
B—etched 2½ minutes after quenching.
C—etched 4 minutes after quenching.
D—etched 8 minutes after quenching.

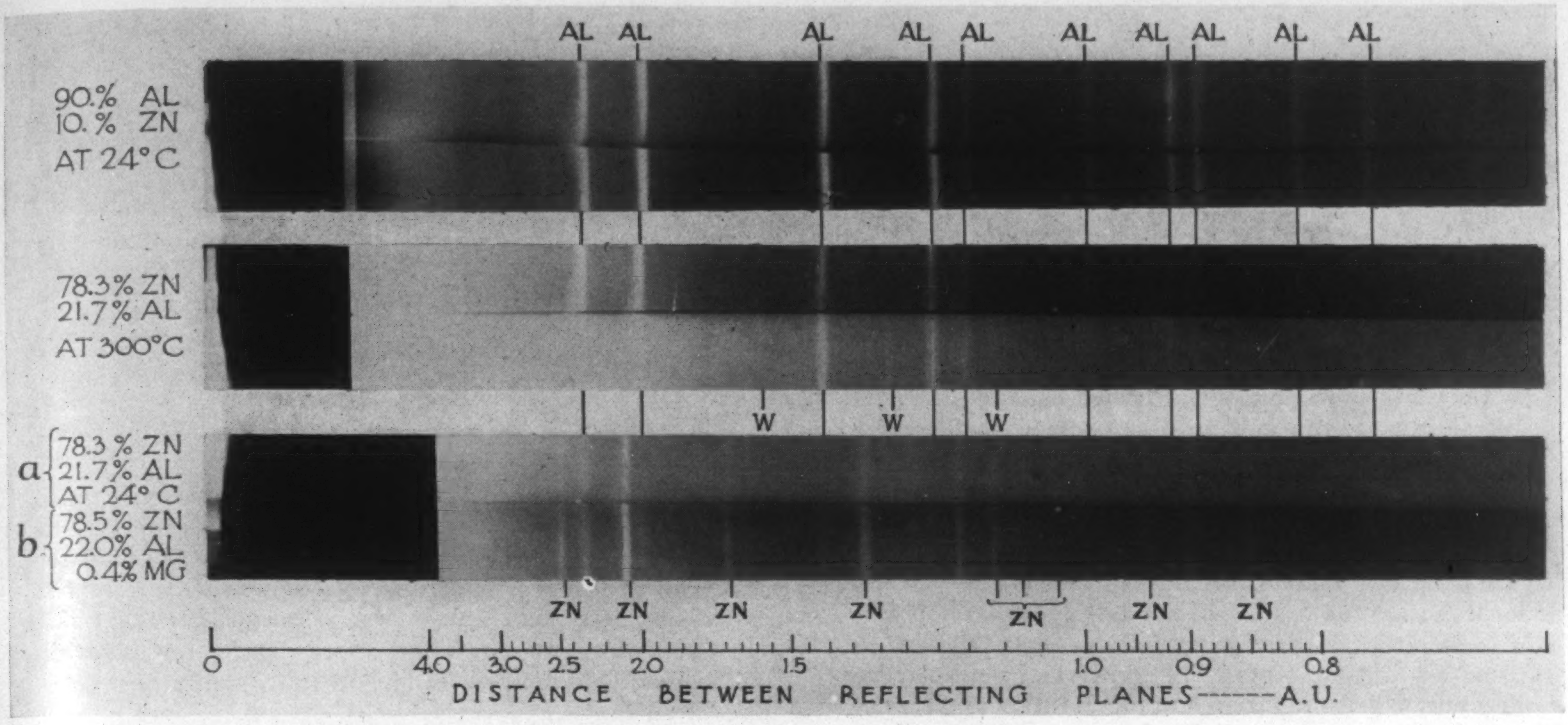

Fig. 7. X-ray powder spectrograms of Al-Zn alloys

Top—face-centered cubic lattice of Al-rich solid solution. Center—face-centered cubic lattice of β phase. Bottom (a)—mixture of hexagonal lattice of Zn and cubic lattice of Al. (Note: Lines marked "w" are due to tungsten heating element.) Bottom (b)—pattern of alloy ZZMG containing 0.4% Mg.

ends sealed into the glass capillary tube and an electric current passed through the wire. The tube was calibrated so that the filings could be held at a temperature between 300° and 360°C. An X-ray pattern of the alloy taken at 300°C. showed a different crystal structure from the one taken at room temperature. These are shown in Fig. 7 and also, for comparison, the pattern of the Al rich solid solution alloy (90% Al). It will be seen that the face-centered cubic structure of Al (γ phase) persists throughout all 3 of the patterns and that the Zn hexagonal type lattice appears only in the pattern of the 78.3% Zn alloy taken at room temperatures. From this evidence it would seem that the β phase, having an Al type lattice, is a simple solid solution of Zn and Al as it exists above 256°C. Its decomposition at temperatures below 256°C. and in quenched alloys at room temperature indicates how narrow is the temperature range in which the Zn and Al atoms can exist in equilibrium in a face-centered cubic lattice at this particular composition (78% Zn). An alloy containing 0.4% Mg (ZZMG Table 3) was also examined. Its X-ray pattern is shown at the bottom of Fig. 7 and indicates the fact that the 0.4% Mg addition did not prevent decomposition of the β phase into $\alpha + \gamma$ solid solution.

4. Dilatometric Examination

The apparatus used for this part of the work has been fully described by Hidnert and Sweeney.[*] Another alloy (Specimen Z 1) containing by analysis 77.6% Zn and 22.4% Al was prepared as previously described and given a similar normalizing treatment. Cylindrical specimens approximately 3″ long and 0.4″ in diameter, with rounded ends were machined from the ingots.

Each specimen was heated at 400°C. for 1½ hours and quenched in ice water. It was then placed in alcohol in the quartz dilatometric vessel and readings taken on the length gage at various intervals after quenching. In Fig. 8 is shown a typical contraction curve together with the corresponding hardness curve. Many determinations were made, by using different specimens of the same composition and by using the same specimen several times. In all cases the curves were practically identical. Figs. 8 and 9 show that most of the contraction occurred during the first 10 minutes after quenching but that there was still a slight change continued over a period of about 4 days. Although there was a very slight decomposition of the β phase after the first 20 minutes, the resultant slight precipitation of α and γ solid solutions did not increase the hardness further, probably since a much greater effect was the relieving of strains set up in the crystal lattice when the β phase first started to decompose.

5. Summarized Properties of the Beta Phase

As shown by Figs. 2 and 3, the quenched β alloy allowed to age at room temperature in air, showed an

Fig. 8. Contraction curve for 77.6% Zn alloy (Minutes)

(Specimen Z1) Hardness curve for 78.3% Zn alloy (Specimen Z)

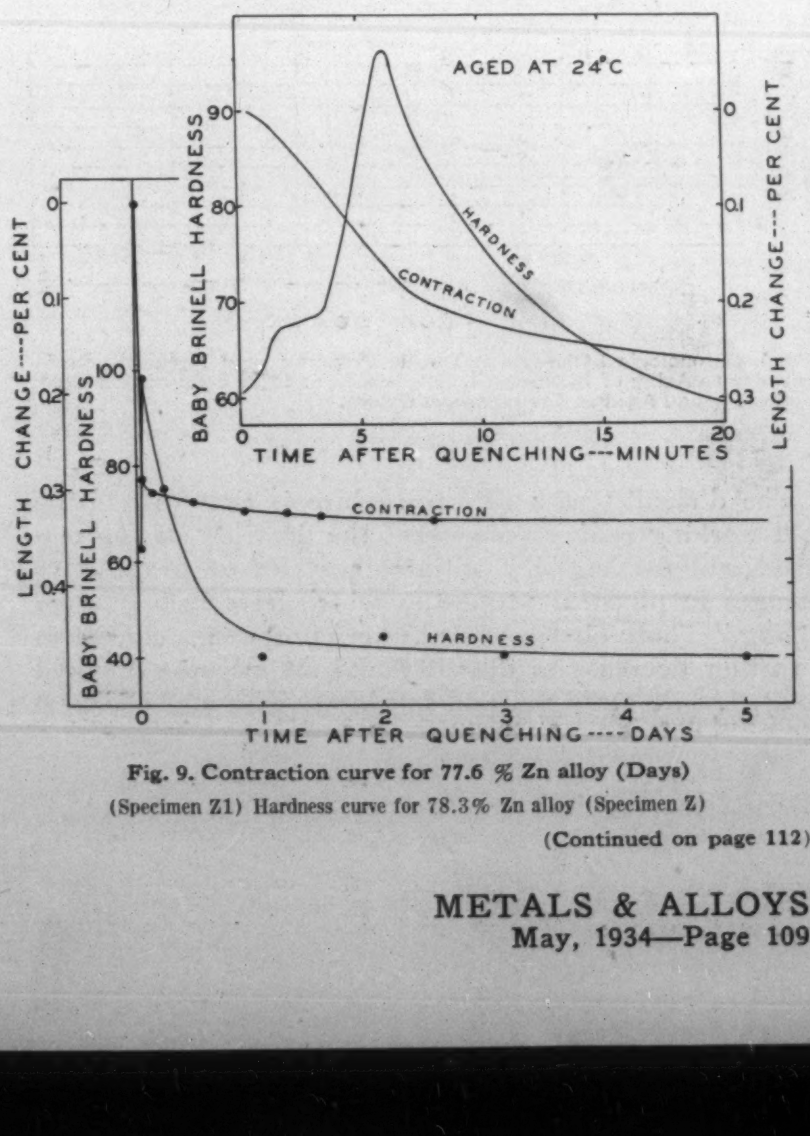

Fig. 9. Contraction curve for 77.6 % Zn alloy (Days)

(Specimen Z1) Hardness curve for 78.3% Zn alloy (Specimen Z)

(Continued on page 112)

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[*] P. Hidnert and W. T. Sweeney. Thermal Expansion of Magnesium and Some of Its Alloys. *Bureau of Standards Journal of Research*, Nov. 1928, Research Paper 29.

Non-aging Iron and Steel for

DEEP-DRAWING

by Anson Hayes* and R. O. Griffis*

THE effects of aging, blue brittleness, and stretcher straining of iron and mild steel have been known for many years and have been subjected to extensive investigation. Embrittlement of boiler plate in the proximity of sheared edges and punched holes was observed as early as 1891 by Stromeyer,[1] who showed that cold working was responsible for this condition. A detailed chronology of aging cannot be given here, but it should be said that Fettweiss[2] will always be remembered as the one who demonstrated that aging and blue brittleness are but different manifestations of the same phenomenon.

One characteristic of iron and steel, such as is used for deep drawing purposes, is that the small amounts of plastic strain that occur as the material passes through the yield point are not uniformly distributed. This results in irregular depressions where the deformation has been localized—a defect commonly called "stretcher straining." While this is a characteristic of iron and steel in the soft annealed condition, it can be temporarily prevented by cold rolling or otherwise imparting a small uniformly distributed initial plastic strain.

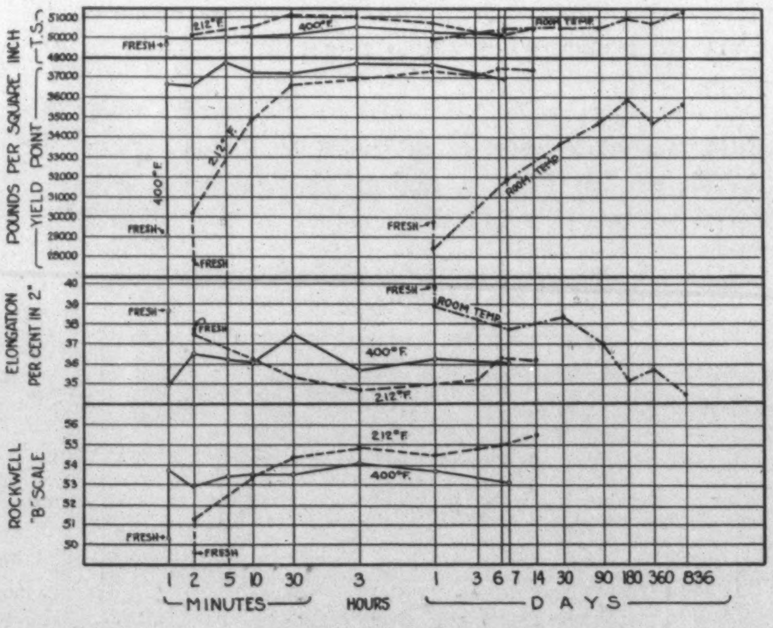

Fig. 1. Chronological Changes in Tensile Properties and Rockwell Hardness due to Aging of Normalized, Box Annealed Mild Steel Sheets Cold Rolled 1% and Aged at Temperatures Shown.

The difficulty with this procedure is that this initial cold working reduces somewhat the ductility of the material and furthermore initiates a series of progressive changes in physical properties which have been termed "aging." These changes in physical properties consist in a further decrease in ductility and an increase in yield point, tensile strength, and hardness. The material also regains its tendency to stretcher strain. The seriousness of this problem in the manufacture and use of high finish deep drawing sheets is well recognized.[3,4]

The changes in physical properties of ordinary mild steel deep drawing sheets cold rolled 1% and aged at various temperatures is illustrated in Fig. 1. The changes in shape of the stress-strain curves are shown in the upper part of Fig. 2. The return of the sharp yield point is accompanied by stretcher straining of the material.

The mathematical relationship between yield point elongation and the severity of the stretcher strains was developed by Kenyon and Burns.[5]

They showed that the depth of the stretcher strain, Δt was a function of both the yield point elongation, $e_{y.p.}$ and the original thickness of the sheet, t_o. The equation relating these variables is as follows:

$$\Delta t = \frac{t_o}{2}\left[\frac{1}{\sqrt{e_{y.p.}+1}} - 1\right]$$

Fig. 3 shows the surface appearance of 5 test samples that had varying amounts of elongation at the yield point. It will be seen that the most severe stretcher strains occur on the specimen that showed the greatest yield point elongation and that the smooth curve corresponded to freedom from stretcher straining.

The initial cold working which is imposed by "temper-cold-rolling" carries the material to a stage where the rate of work hardening is high enough to prevent any decrease in load with further deformation and if aging can be prevented the material remains non-stretcher-straining. The problem then is to prevent aging.

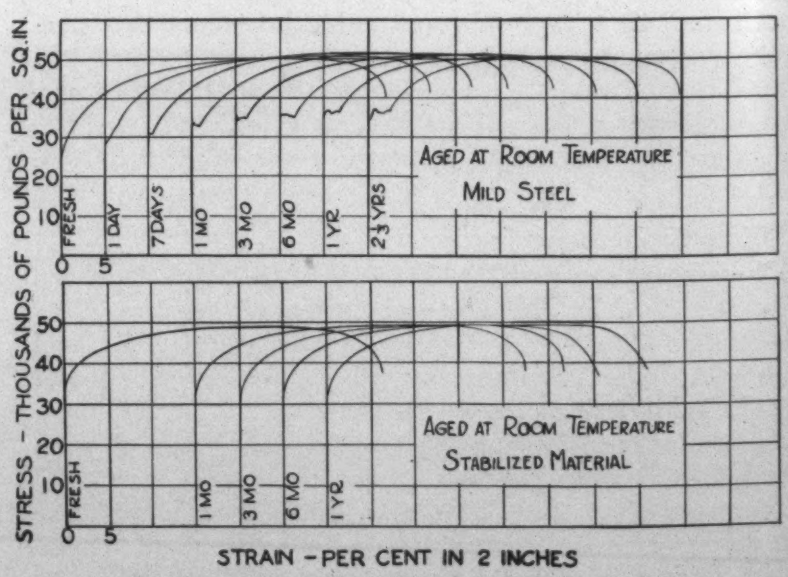

Fig. 2. Upper Half: Stress Strain Curves of Ordinary Mild Steel Cold Rolled 1% and Aged at Room Temperatures. Lower Half: Same for Stabilized Material.

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*American Rolling Mill Company.

[1] C. E. Stromeyer. The Aging of Mild Steel. *Journal Iron & Steel Institute,* Vol. 73, 1907, pages 200-260.

[2] F. Fettweiss. Ueber die Blaubrüchigkeit und das Altern des Eisens. *Stahl und Eisen,* Vol. 39, 1919, pages 1-7, 34-41.

[3] Thomas Dockray. Sheet Steel—Its Drawing Quality. *Metal Progress,* Vol. 20, 1931, pages 54-59.

[4] R. O. Griffis, R. L. Kenyon & R. S. Burns. The Aging of Mild Steel Sheets. *Yearbook American Iron & Steel Institute,* Vol. 23, 1933, pages 142-165.

[5] R. L. Kenyon & R. S. Burns. Autographic Stress-Strain Curves of Deep Drawing Sheets. *Transactions American Society for Steel Treating,* Vol. 21, 1933, pages 577-612.

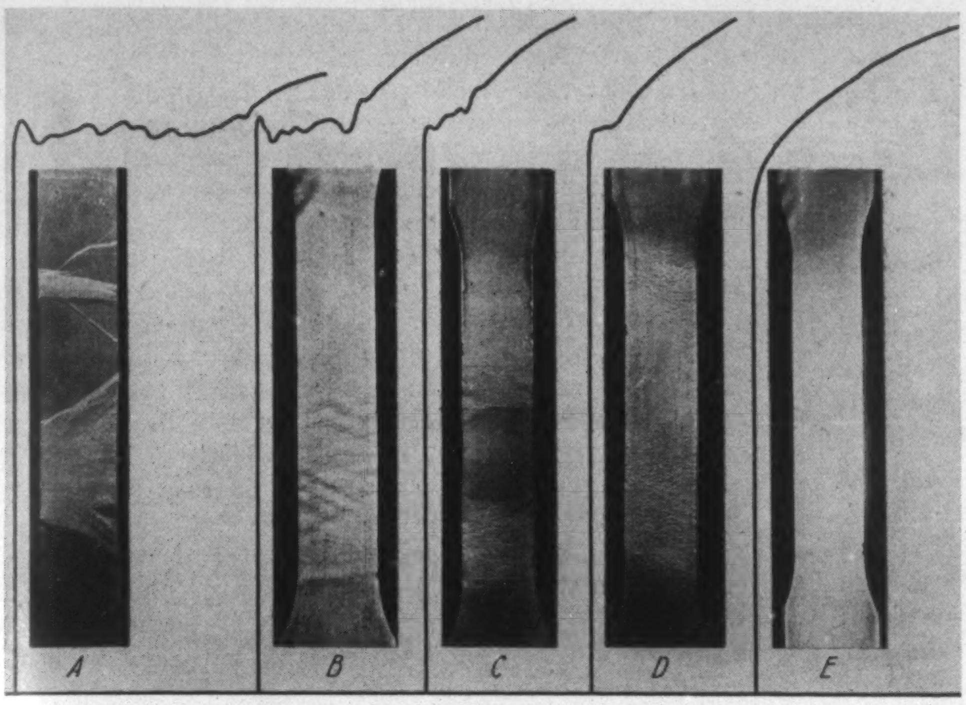

Fig. 3. Relationship between Severity of Stretcher Strains and Amount of Elongation at the Yield Point.

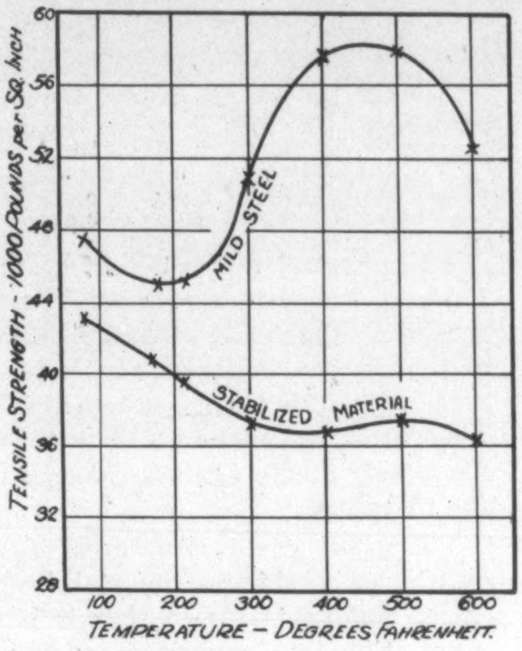

Fig. 4. Blue Brittle Characteristics of Mild Steel and Stabilized Material as Shown by the Effect of Temperature on Tensile Strength.

An announcement[6] was made several months ago of a ferrous material which was unique in that it was free from blue brittleness and did not age. The stress-strain curves in the lower half of Fig. 2 are of a series of samples of this material after cold rolling 1% and aging various lengths of time at room temperature.

These curves should be compared with those for ordinary mild steel in the upper half of the same illustration. It is evident that the aging treatment has not affected the shape of the stress-strain curves of the stabilized material. There is no return of a sharp yield point and the material was completely free from stretcher strains in all cases.

This material which is stable against changes due to aging is also free from blue brittleness as indicated by the fact that the tensile strength does not increase in the blue brittle range as is the case with mild steel. This is shown in Fig. 4. The points through which the curves are drawn are averages of duplicate tests which agreed very closely (the maximum difference between any two tests was 1700 and the average difference 625 lbs./in.[2]. On account of this close agreement only the averages have been plotted. This relationship between tensile strength and testing temperature is entirely in accord with the hypothesis of Fettweiss[2] who demonstrated the relation between aging and blue brittleness.

Another important property in deep drawing sheet material is uniform ductility. In this respect the material which is stabilized against changes due to aging is as good or better than the mild steel sheets regularly supplied for this purpose. The uniform properties of this material are indicated by the data in Table I in which the values tabulated represent single tests and are alternately from edge and center of 3 finished sheets.

Table I

	Yield Point	Tensile Strength	Elastic Ratio	% Elongation in 2"	Rockwell
	29150	46900	62.2	42	B-45
	28600	47500	60.2	41	45
	30000	46600	64.3	40	42
	29000	47500	61.0	44	44
	29350	46600	63.0	38	43
	29750	47500	62.6	41	44
Average	29310	47100	62.2	41.0	43.8

This material possesses the further advantage over ordinary mild steel in that the amounts of cold rolling commonly used for tempering the sheets do not impair the ductility. A comparison of the new material with mild steel deep drawing sheets in this respect is given in Fig. 5. This advantage is most important in case of very severe drawing requirements which ordinarily demand a very close adjustment of the amount of temper rolling to prevent breakage on the one hand and stretcher straining on the other.

Essentials for Obtaining a Ferrous Material Stable Against Changes Due to Aging

When this material was announced several months ago, we could give only its properties. Great interest has been shown in it and in the essentials in its production. It has just recently become possible to publish this information.

The necessary conditions for obtaining a material stable against changes due to aging are certain characteristics of composition and processing treatment. No attempts will be made here to develop any generalizations in regard to either of these essentials. Rather, we will

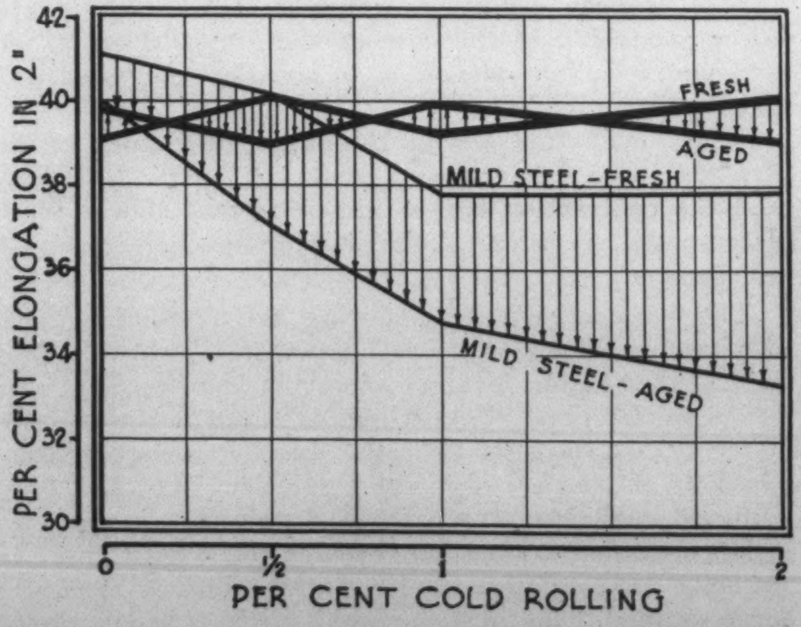

Fig. 5. Effect of Temper Rolling on Ductility of Mild Steel and Stabilized Material.

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[6] Anon. Announces a New Deep Drawing Steel. *Iron Age*, Vol. 132, 1933, pages 27-28.

cite certain typical compositions and processing treatments which are successful.

Among the compositions that are capable of being stabilized, the following are examples:

	C	Mn	P	S	Si	Ti	Al
1	0.05	0.03	0.005	0.019	..	0.067	0.042
2	0.042	0.47	0.011	0.014	0.073	0.058	0.037

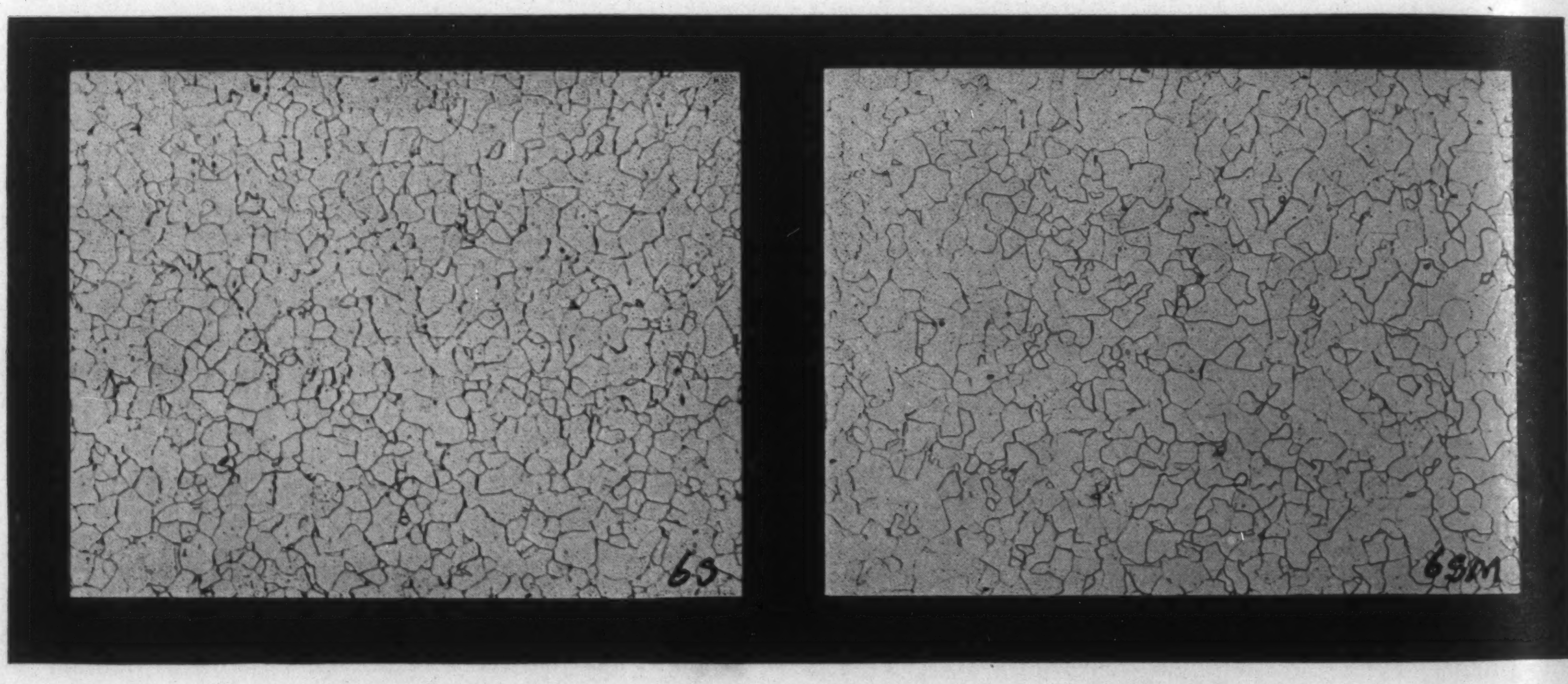
The physical properties of composition 1 are given in Table I. The data represented in Figs. 2, 4, and 5 were obtained on material of composition 1. Similar tests have been made on material of composition 2 and they are such as to indicate its suitability for a large variety of deep drawing purposes. The material is found to be completely stable against changes in physical properties due to aging.

The usual grain structures of mild steel sheets are readily obtainable in the stabilized material. It differs from rimming steels in that it is essentially free from segregation in composition and variation in grain size throughout the structure. Fig. 6 shows a comparison of the structures of deep drawing sheets of ordinary steel and the stabilized material.

The essentials of the processing treatment aside from the attainment of the desired composition are that the material be given a stabilizing heat treatment in which it is held the proper length of time at the correct temperature and cooled at suitable rates. The following is given as an example of a suitable heat treatment for these compositions.

In the production of an extra deep drawing sheet which is stable against changes due to aging, heat treatments containing a normalizing operation are being used, following which the material is given a final treatment, an example of which consists of holding at 1180°F. for approximately 3 hours and then cooling at a rate of about 10° to 15°F. per hour.

We have also produced other materials which can be stabilized against changes due to aging. These may contain either higher or lower carbon and manganese and the titanium and aluminum may be replaced with other deoxidizers.



Mild Steel

Stabilized Material

Fig. 6. Microstructure of Deep Drawing Sheets of Ordinary Mild Steel and Stabilized Material.

Dimensional Changes in Die Casting Alloys

(Continued from page 109)

evolution of heat, the intensity of which was proportional to the relative amount of β phase present. The maximum heat evolution occurred about 4½ minutes after quenching in the case of the 100% β alloy, and 1½ minutes after quenching in an alloy composed only partly of the β phase.

X-ray evidence showed the lattice structure of the β phase to be face-centered cubic, similar to that of Al, and the contraction curves indicated that this β phase decomposed according to the simple monomolecular type of reaction.

The maxima of curves showing age-hardening of the β phase, retained at room temperature by quenching, coincided with the maxima of curves showing heat evolution in the same alloy, which fact can be interpreted to mean that the heat liberated was the energy of combination of the α and γ solid solutions into the face-centered cubic structure of the β phase.

Microscopic examination revealed the formation of an intimate mixture of α and γ solid solutions from the large-grained, homogeneous β phase which began almost immediately after quenching. This formation of a small-grained structure from a large-grained one, probably accompanied by a straining of the crystal lattice, accounts for the marked increase in hardness when the change $\beta \rightarrow \alpha + \gamma$ takes place. The subsequent relieving of lattice strains must account for the decrease in hardness after the maximum has been attained since no microscopic evidence of the coalescence of fine grains into large ones was observed.

Most of the shrinkage of the quenched β alloy occurred during the first 10 minutes after quenching and coincided with the rapid rate of increase in hardness. Slight shrinkage continued until about 4 days after quenching.

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[5] Pierce. *Transactions American Institute Mining & Metallurgical Engineers*, Vol. 68, 1923, page 767.

[6] Fraenkel & Goez. *Zeitschrift für Metallkunde*, Vol. 17, 1925, page 12.

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[9] Brauer & Peirce. *Transactions American Institute Mining & Metallurgical Engineers*, Vol. 68, 1923, page 796.

This article will be concluded in the June issue

ORE CONCENTRATION (1)

JOHN ATTWOOD, SECTION EDITOR

The Follsain Processes. *Mining Journal*, Vol. 181, June 24, 1933, pages 435-436. The Follsain processes are divided into 3 main groups: (1) volatilization for treatment of pure and complex ores of Pb, Zn, Sn, As, etc., (2) agglomeration of Fe and Mn ores and magnetic concentration of roasted Fe ores, and (3) thermal treatment of metals on principles of diffusion by inter-solid penetration for production of metals highly resistant to oxidation at high temperatures and to acid attack. AHE (1)

The Tungsten Ores—Their Mining, Concentration, and Marketing (Wolframmalmerna—deras brytning, anrikning och försäljning) ERNST ROTHELIUS. *Blad för Bergshandteringens Vänner*, Vol. 21, No. 4, pages 81-105. Contains a short review of concentration methods used in Cornwall and Australia, with flow sheet; discusses magnetic concentration with Wetherill separators and the Oxland process for separating cassiterite and scheelite. BHS (1)

The Blomco Thickner. A New Departure in De-Watering. *Mining Journal*, Vol. 183, Oct. 14, 1933, pages 709-710. A number of metal tubes 6 ft. long and 6 in. in diameter covered with filtering canvas are suspended in a tank containing the pulp. Vacuum on the inside of the tubes builds up a cake on the canvas, which increases resistance to a point at which it automatically breaks the vacuum, dropping the cake, after which the cycle is started again. AHE (1)

The Concentrating Practice of the Broken Hill South Limited. T. A. READ. *Proceedings Australasian Institute of Mining & Metallurgy*, No. 88, Dec. 31, 1932, pages 247-339. Jigs and tables recover 60% of the total Pb in a concentrate assaying Pb 77% and Zn 3.3%. Total recovery by a combined gravity and flotation system equals that from all flotation; and, although capital costs are more, grinding costs are less, the coarse concentrate commands a higher price than a flotation slime, the coarse mill residues can be used as mine filling (slimes are unsatisfactory), and treatment costs are less. The flow sheet and equipment are described in detail. Feed to the Pb flotation section assays Pb 13.5%, Zn 14.4% and Ag 9.4 oz./ton. The cleaner concentrate assays Pb 72.3%, Zn 5.3% and Ag 49.4 oz./ton. Reagents are soda ash 1.165, Na silicate 0.305, potassium ethyl xanthate 0.054, and eucalyptus oil 0.104 lb./ton. The deleaded residue, assaying Pb 0.8%, Zn 16.4% and Ag 0.7 oz./ton, goes to the Zn circuit. The scavenging Pb flotation section is fed sand from a classifier; it assays Pb 4.3%, Zn 15.2% and Ag 5.1 oz./ton. A concentrate assaying Pb 30.9%, Zn 24.6% and Ag 36.0 oz./ton is returned to the primary grinding circuit and the tailing, Pb 0.8%, Zn 13.9 and Ag. 1.0 oz., go to the Zn circuit. Reagents are essential oil "C" 0.033 Roylo "C" 0.034 and potassium ethyl xanthate 0.015 lbs./ton. In the Zn circuit, soda ash 0.444, lime 0.061 $CuSO_4$ 1.075, eucalyptus oil 0.329, potassium ethyl xanthate 0.090 and Na Aerofloat 0.046 lb./ton give a concentrate assaying Pb 1.4%, Zn 52.7% and Ag 1.5 oz./ton. The residue assays Pb 0.7%, Zn 1.9% and Ag 0.6 oz./ton. Total costs are 8.27 s./ton of crude ore. AHE (1)

Crushing, Grinding & Plant Handling (1a)

Mechanical Crushing to the Colloidal Range (Mechanische Zerkleinerung bis in kolloidale Gebiete) E. PODSZUS. *Kolloid Zeitschrift*, Vol. 64, Aug. 1933, pages 129-143. The conditions of grinding and crushing of particles of colloidal dimensions are discussed. It is shown that all grinding plants operate with a low efficiency which is almost independent of the fineness of the product. A grinding process is described which permits crushing and grinding dry as well as viscous metals down to colloidal state. 25 references. Ha (1a)

Gravity Concentration (1b)

Extraction of Ferruginous Lead Concentrates from Oxidized Lead Ores of the Kara-Ken-Sai Deposit (Kasakstan, Turlan District, U. S. S. R.) S. I. POLKIN. *Tzvetnuie Metallui*, Dec. 1932, pages 10-49. The ores of the district contain 16-18% Pb, 2.3% Zn, and 36% Fe. They are oxidized Pb-Fe ores consisting mainly of limonite and cerussite, loose and porous, and contain large amounts of colloidal slimes. The separation of Zn, Pb and Fe presented a difficult problem. Attempts were made to obtain iron ochre and the Pb concentrates. Because of the large proportion of slimes (50%) table concentration was found to be inapplicable. After much experimentation it was found that 85-87% extraction of Pb could be attained by flotation with coal tar. The Zn could not be floated, but remained uniformly distributed among the products of flotation. The slimes containing iron ochre are contaminated with Pb and Zn, and could not be used for the manufacture of ochre paint; however they can be used for the manufacturing of varnish. The investigation is incomplete, and further work is needed to clarify certain points. BND (1b)

Flotation (1c)

Flotation of Bakr-Usyak Sulphidic Copper Ore. (South Ural). A. S. SLADKOV. *Tzvetnuie Metallui*, July-Aug. 1932, pages 93-107. The ores contain 5.85% Cu, 0.5 g. Au/ton, and 21.6 g. Ag/ton. The Cu occurs as chalcocite and chalcopyrite. Flotation of the finely ground ores (95% of the ore through 200 mesh) gave good results, the recovery being: Cu 97-98%, Au 81% and Ag 70%. Mineralogical composition of the ore, details of the flotation methods, reagents used, etc. are described. BND (1c)

Mechanism of the Flotation Process (Mechanismus des Flotationsvorganges) D. TALMUD. *Kolloid Zeitschrift*, Vol. 62, Mar. 1933, pages 335-343. The nature of the flotation process as a colloidal phenomenon is discussed and it is shown that the forces effecting the mechanical separation are due to the behavior of particles repelled by water. A new method is developed utilizing this fact. Ha (1c)

Oxygen-free Flotation, I.—Flotation of Galena in Absence of Oxygen. S. FREDERICK RAVITZ & ROBERT R. PORTER. *American Institute Mining & Metallurgical Engineers, Technical Publication* No. 513, Dec. 1933, 17 pages. An apparatus was constructed for carrying out flotation in an atmosphere of N from which all O was excluded. O was removed from the ore by leaching with ammonium acetate. Pure unoxidized galena floated completely and very rapidly with either terpineol or xanthate solution. It even floated in the absence of any reagents. Tests with oxidized galena showed that O inhibited flotation. The several theories of flotation are discussed and it is shown that the results obtained tend to disprove the chemical theory. 18 references. JLG (1c)

Flotation Methods for Separating Minerals. *Crushing & Grinding*, Vol. 2, Nov.-Dec. 1933, page 96. General. AHE (1c)

The Chemical Basis of Flotation. I. W. WARK. *Proceedings Australasian Institute of Mining & Metallurgy* No. 90, June 30, 1933, pages 83-123. Contact angles between pure minerals and collectors containing CH_3 group were 50°, C_2H_5 group 60°, C_3H_7 group 74°, benzyl 71°, etc. The author postulates surface absorption leaving the non-polar group always exposed. Curves of pH versus NaCN concentration show limiting conditions for contact for various minerals. The function of alkali present with NaCN as a depressant is solely to control the cyanide ion concentration which in turn is the factor determining whether or not contact can occur. AHE (1c)

Influence of the Concentration of Ores by Flotation on Metallurgy (Influence de la Concentration des Minerais par Flottage sur la Métallurgie) E. PROST. *Revue Universelle des Mines*, series 8, Vol. 9, Oct. 1, 1933, pages 521-529; Oct. 15, pages 550-556; Nov. 1, 1933, pages 581-587. The great progress made in the metallurgical field during the last 15 years due to the application of flotation processes for concentration of ores and especially by "selective flotation" has made possible the working of formerly neglected low-grade ores. The various methods in use for Cu, Pb and Zn, especially in the U.S.A. are described and statistics given; flotation is combined here with and without roasting. The method has proved to be very advantageous for an ore of Pb, Zn and Fe in about equal proportion and with about 40-65% insolubles. Applying flotation for Zn ores, minerals richer in Zn are obtained and poorer in Pb, Ag and in gangue than with the older methods; roasted concentrates can exceed 60% Zn with only 0.5% S, and the resulting Zn grains are easily reduced by the CO in the reduction furnaces. Au and Ag ore concentration by flotation has been developed in the last 6 years and is particularly useful when Au is in the form of tellurides or other combinations not suitable for direct amalgamation or cyanization; sometimes some of these processes are combined as in the case of a mineral containing Au and W (scheelite of Montana). The Mond Nickel Co. uses a flotation process for Ni and Cu containing pyritic ores of Canada containing also Au, Pt, Pd and other Pt-metals. Concentration of Sn ores is still under study and, though in use, is not yet generally applied. Hg ores are concentrated from 1% up to 95%. Selective flotation permits easy separation of molybdenite (MoS_2). W-ores do not give as good results as Mo ores on account of the high density of W; flotation has, however, been used for, besides scheelite, also ferberite (iron tungstate) for separation from silicious gangue. Flotation of Pt-metals is difficult and complicated, Pt and its metals being transformed into water-soluble double-chlorides. The very exhaustive discussions and descriptions of the article must be referred to for further details. 36 references. Ha (1c)

Magnetic Separation (1d)

Magnetic Pulleys in the Non-Ferrous Metal Industries. C. H. S. TUPHOLME. *Metal Industry*, London, Vol. 43, Nov. 17, 1933, pages 485-486. Magnetic pulleys and their application as magnetic separators in ore dressing are discussed and arrangements for collecting and removing the magnetic material on the rim of the pulley described. When separating Fe from non-ferrous metals the material collected on the pulley should not exceed 2 in. in depth, pulley speed should be about 38 r.p.m.; 550 to 14000 cu. ft. of material can be treated per hr. with pulleys of 12-30 in. diameter. Ha (1d)

Amalgamation, Cyanidation & Leaching (1e)

Investigation of Riffle Concentrate from McLeod River Mining Corporation, Ltd., Peers, Alberta. C. S. PARSONS. *Canada Department Mines, Mines Branch, Report* No. 728, 1932, pages 60-62. A black sand gave 99% recovery of Au by amalgamation. AHE (1e)

The Gold Deposits of Nova Scotia. E. S. ROMILLY SMITH. *Canadian Mining & Metallurgical Bulletin*, No. 246, Oct. 1932, pages 589-594. Discussion of paper abstracted in *Metals & Alloys*, Vol. 4, May 1932, page MA 162. AHE (1e)

Gold Tellurides are Soluble in Cyanide. W. E. JOHNSTON. *Transactions, Canadian Institute of Mining & Metallurgy, 1933, (in Canadian Mining & Metallurgical Bulletin* 254, June 1933), pages 224-225. Ordinary high lime solution is suitable for dissolving Au tellurides. O_2 is necessary, but apparently not more so than in dissolving Au. AHE (1e)

The San Antonio Gold Mine. J. A. REID & D. J. KENNEDY. *Canadian Mining & Metallurgical Bulletin* No. 256, Aug. 1933, pages 495-505. Free Au occurring in quartz and pyrite is recovered by cyanidation. Details are given. AHE (1e)

The Recovery of Gold from the Ore of the Leroy Mines, Ltd., Township of Louvicourt, Que. ALEX. K. ANDERSON. *Canada Department of Mines, Mines Branch, Report* No. 728, 1932, pages 71-74. A quartz ore assaying Au 4.47 oz. and Ag 0.19 oz./ton gave 74.5% extraction by amalgamation at 48 mesh and 89.7% at 150 mesh. Amalgamation followed by cyanidation gave 99.6% recovery. AHE (1e)

The Recovery of Gold from the Ore of the Hayden Gold Mines Co., Ltd., Timmins, Ont. ALEX. K. ANDERSON. *Canada Department of Mines, Mines Branch, Report* No. 728, 1932, pages 68-71. A siliceous ore with a little fine-grained pyrite assaying Au 0.23 oz. and Ag 0.04 oz./ton gave 82.6% recovery with amalgamation and cyanidation of tailings and 87% recovery with direct cyanidation. AHE (1e)

Radium and Uranium from Great Bear Lake Ore. *Canadian Chemistry & Metallurgy*, Vol. 17, Dec. 1933, pages 252-253. Ra and U have recently been extracted from the ores of this district. The ore is crushed, roasted, pulverized to 35-mesh, boiled with HCl, filtered on a stoneware filter, and washed with water. The residue containing the Ra is treated with saturated salt solution to dissolve the lead chloride. A certain amount of Ba must be present before boiling with sodium carbonate to convert both Ba and Ra to carbonates. Filtering leaves the carbonates along with the silica. The carbonates are dissolved in hydrochloric acid and Ba and Ra reprecipitated as sulphate. The sulphate mixture contains 2-10 mg. Ra/kg. The sulphates are again converted to carbonate, washed, dissolved in hydrobromic acid and the solution purified by the use of barium hydrate. Ra and Ba bromides are separated by fractional crystallization. U is recovered as Na-salt. WHB (1e)

A Research on Location and Constitution of Residual Gold after Cyaniding. J. R. THURLOW. *Journal Chemical, Metallurgical & Mining Society of South Africa*, Vol. 33, Apr. 1933, pages 330-331. See *Metals & Alloys*, Vol. 4, Nov. 1933, page MA 370. AHE (1e)

The Development of Gold Mining in Morobe, New Guinea. HAROLD TAYLOUR & I. W. MORLEY. *Bulletin Institution Mining & Metallurgy*, No. 347, Aug. 1933, 61 pages. Metallurgical practice is described briefly. AHE (1e)

Chemistry of the Reaction between Ferrous Oxide and Cuprous Oxide Salts and between Ferric Oxide and Cuprous Oxide Salts (Beiträge zum Chemismus der Reaktionen zwischen Eisenoxydul- und Kupferoxydulsalzen einerseits und Eisenoxyd- und Kupferoxydulsalzen andererseits) R. ROSENDAHL. *Die Metallbörse*, Vol. 23, Apr. 1, 1933, pages 413-414. 24 formulae are presented relating to important chemical reactions in hydro metallurgical reactions, particularly in solutions from chlorinating roasted pyrite. EF (1e)

Preparation of Vanadium from Aegirine. M. B. ZAPADINSKY & V. M. ZHOGINA. *Tzvetnuie Metallui*, May-June, 1933, pages 68-73. Extraction of V from aegirine with acids is low. Roasting at 850-950° with 15% of chalk or lime followed by treatment with acid gave 80-90% recovery. Pure vanadate of Fe was obtained by adding Fe and neutralizing the solution, but the ratio V:Fe was too low, and the process can be applied only to low P ores. For high P ores, all the V is separated from Fe to obtain V_2O_5. The charge roasted with lime or chalk is dissolved in HCl, the solution is neutralized with CaO, and the precipitate is treated with ammonia; 92 to 95% of the V is extracted. The solution is evaporated to dryness to obtain V_2O_5. The ammoniacal solutions were free from P, Al, Fe, etc., and contained only a small amount of SiO_2 and traces of Ca. BND (1e)

ORE REDUCTION (2)

A. H. EMERY, SECTION EDITOR

Non-Ferrous (2a)

The Continuous Refining of Lead Bullion. G. K. Williams. *Chemical Engineering & Mining Reveiw,* Vol. 25, Oct. 5, 1932, pages 8-12; *Engineering & Mining Journal,* Vol. 134, July 1933, pages 285-286. See "Description of Continuous Lead Refinery," *Metals & Alloys,* Vol. 4, Nov. 1933, page MA 371. WHB (2a)

New Lead Refinery of U. S. Smelting in Operation at Midvale, Utah. *Engineering & Mining Journal,* Vol. 134, Nov. 1933, page 431. The capacity is 6000 tons/month. Features of the plant include kettles of rolled and welded steel, a mechanical dross-skimming pan (crane-operated), and new Pb pumps. The dezinking machinery produces $ZnCl_2$ of high quality. The de-silvering machine is operated with directly-connected motors and built to withstand high temperatures. The parting plant and the electrolytic refining plant are functioning satisfactorily. WHBp (2a)

Zinc-Blende Treatment. *Electrician,* Vol. 111, Oct. 20, 1933, page 472. Electrical precipitation plant for purifying gases produced by roasting is described. The gases are treated before cooling by a dry process; after the gases are cooled, all traces of As are removed by a wet process. CBJp (2a)

Treatment of Zinc Plant Residues. S. Tonakanov. *Tzvetnuie Metallui,* Sept. 1932, pages 64-86. An improvement of the Waelz process for treating residues from Zn distillation is described. It makes possible the extraction of all the non-ferrous metals present in the residues. The average recovery of Zn is 90-98%, of Cu 90%, and of Ag 55%. BNDp (2a)

Experiments in Flash Roasting. Frank S. Wartman. *American Institute Mining & Metallurgical Engineers, Technical Publication* No. 514, Dec. 1933, 12 pages. Small-scale experiments on the roasting of finely divided chalcocite and chalcopyrite by dropping them through a heated chamber 60" high and 2" internal diameter are described. Effects of particle size, temperature, direction of draft, height of furnace, and variations in the air-mineral ratio were studied. Roasting proceeded almost instantaneously. 3 Cu ferrites were formed—cuprous ferrite ($Cu_2O{\cdot}Fe_2O_3$) and 2 cupric ferrites ($CuO{\cdot}Fe_2O_3$), one cubic and one tetragonal. Ferrites are relatively insoluble in the ordinary leaching liquids used for Cu recovery. 10 references. JLG (2a)

Smelting Operations at Roan Antelope Copper Mines, Limited. Charles R. Wraith. *American Institute Mining & Metallurgical Engineers, Technical Publication* No. 511, Nov. 1933, 25 pages. The metallurgy, reverberatory furnace, and convertors are described in detail. The concentrate, consisting of chalcocite and shale, analyzes 58.67% Cu, 13.4% SiO_2, 3.90% FeO, 0.10% CaO, 4.12% Al_2O_3, 0.70% MgO, and 16.02% S. The charge is 100 units concentrate, 6 limestone and 3.6 matte reverts. The matte is almost pure Cu_2S and contains 79.0% Cu and only 0.5% Fe. No difficulty is encountered in blowing it. The blister Cu is cast into 350-lb. cakes (18"x28"x3") on a straight-line machine. The reverberatory furnace is fired with powdered coal and will yield matte equivalent to 5900 short tons of Cu per month. JLGp (2a)

The Oxidation of Molten Copper Containing Small Amounts of Nickel, Arsenic, Tin, and Antimony (Über den Oxydationsverlauf von flüssigen Kupferschmelzen mit geringen Gehalten an Nickel, Arsen, Zinn und Antimon) P. Siebe & C. Busse. *Metall und Erz,* Vol. 30, July 1933, pages 273-280. Cu was alloyed with 0.1 to 1% of Ni, As, Sn, and Sb, melted in an electric tube furnace at 1100° C. and oxidized with N containing a small percentage of O. The tendency to oxidize was in the order: Sn, Sb, Ni, and As. Except for As this is the same order as their heats of oxidation. In the Sn and Sb alloys the O first combines with all the Sn and Sb, then with the Cu. However, the removal of the last traces of Sn and Sb is prevented because their oxides are soluble in Cu and Cu_2O. In the Ni and As alloys some Ni and As remains in the metallic state even after the Cu oxidizes. In standard blast furnace practice As can better be removed by volatilization than by slagging off. CEMp (2a)

Chlorine Smelting with Chloride Electrolysis. E. A. Ashcroft. *Bulletin Institute of Mining & Metallurgy,* No. 350, Nov. 1933, 65 pages; discussion, No. 351, Dec. 1933, pages 1-27. All the metals in sulphide ore are converted to chlorides with Cl_2 and reduced to $ZnCl_2$ by precipitation with Zn. The fused $ZnCl_2$ is electrolyzed to produce Zn and Cl_2. Elemental S is recovered. The history of the development of the process by Swinburne and its subsequent use is discussed. Flow sheets are given and individual steps, including removal and separation of impurities, are described in detail. One lb. Zn is obtained per kw. hr. Costs are estimated at £3 16 s/ton Zn from 50% concentrate without credit or costs for by-products. AHE (2a)

Ferrous (2b)

Effect of Silica Content of Iron Ore on Smelting Cost (Einfluss des Kieselsäuregehalts von Eisenerzen auf ihre Verhüttungskosten) K. Grethe, J. Stoecker & von M. Paschke. *Archiv für das Eisenhüttenwesen,* Vol. 7, July 1933, pages 1-6. German Fe ore is high in SiO_2. Blast furnace operating data are given which show that more CaO is required, and the slag volume and coke consumption are increased. The cost of smelting German Fe ore is considerably higher than that for the lower SiO_2 foreign ore. SEp (2b)

The Hot Blast in Iron Smelting. W. McConnachie. *Iron & Coal Trades Review,* Vol. 126, Apr. 7, 1933, pages 534-535. Some of the advantages credited to the hot blast to coal fired smelting furnaces are due to the superiority of raw bituminous coal over coke. Tarry vapors from raw coal are condensed in the pores of the ore; vaporization in the hotter zones results in a more intimate intermixture of solid C, derived from tar, with the metallic oxides than is possible using coke. When hot blast is used in coke furnaces 2 other reducing agents come into play,—the metals of the alkalies, produced and acting on the oxides in the space immediately over the slag in the well, and the cyanide formed in the same space but acting on the oxides of the ore at higher levels in the furnace. Both these agents are superior to CO in reducing power as the latter can act advantageously only at comparatively low temperatures and only if a large excess of CO is present. Ha (2b)

Treatment of Iron Ores and Blast Furnace Flue Dust by the Foilsain Agglomeration Method (Die Behandlung von Eisenerzen und Hochofen-Flugstaub nach dem Foilsain-Verfahren der Agglomeration) *Montanistische Rundschau,* Vol. 12, 1933, pages IX-X. Digest of an article published in the Iron & Coal Trades Review, June 16, 1933. To sinter, Fe_2O_3 is converted into Fe_3O_4. The ore is mixed with coke and exposed to the hot blast at 800° C. The sinter may then be concentrated by magnetic methods. The process can be used for sintering manganese ores. Test plants in Antheuil, France, in operation for 2 years have given good results for various types of ores and flue dusts; a plant with daily capacity of 250-300 tons will be erected in England. BHS (2b)

Direct Reduction of Vanadium-bearing Iron Ores in the Manufacture of High-grade Steels. *Metallurgia,* Vol. 9, Nov. 1933, pages 1-3. At a Norwegian plant, ores containing V and Ti are reduced to high grade steel without the loss of these elements. JLG (2b)

MELTING, REFINING & CASTING (3)

Filling of Molds and Calculation of Feeding Heads. (Remplissage des Moules et Calcul des Jets de Coulée.) T. Miaskowski. *Bulletin de l'Association Technique de Fonderie,* Vol. 16, Sept. 1932, pages 519-524. Polish exchange paper at World Foundry Congress, Paris, Sept. 1932. Formulae and tables for gate dimensions. Flow of metal through gate is considered as flow of water through a tube, with modifications for mold conditions, types of castings and differences in metals. See "The Filling of the Mold and Calculation of Gates and Risers," *Metals & Alloys,* Vol. 4, Oct. 1933, page MA 330. WHS (3)

Must Correlate Castings Design and Foundry Practice. Alex Taub. *Foundry,* Vol. 60, April 1932, pages 47, 88-89. Abstract of paper read at meeting of Philadelphia Foundrymen's Association and members of American Foundrymen's Association. In new products or new designs consideration must be given not only to known foundry practice, but to specific foundry practice available to the designer. Design should incorporate proper draft considerations and fewest possible external cores. External cores are the first signs of design weakness. One of the most troublesome by-products of foundry is the fin, particularly if fin is located in water passage. See *Metals & Alloys,* Vol. 4, Sept. 1933, page MA 298. VSP (3)

Use of Wooden Bars in Pattern Making (Die Verwendung von Sperrholz im Modellbau) Arno. *Zeitschrift für die gesamte Giessereipraxis,* Vol. 54, July 23, 1933, pages 310-311. In a few examples author shows economic use of wooden bars in pattern making. Wooden bars have the advantage of not distorting, thus saving repair costs on patterns. GN (3)

Processing of a Molding Plate with Stripping Device (Herstellung einer Formplatte mit Abstreifkamm) *Zeitschrift für die gesamte Giessereipraxis,* Vol. 54, June 4, 1933, pages 231-233. Description of the device developed for molding a special type of casting. GN (3)

Why Double Patterns? (Warum Doppelmodelle?) *Zeitschrift für die gesamte Giessereipraxis,* Vol. 54, June 11, 1933, pages 251-252. Shows where double patterns are advantageously used, for instance, in casting insulator caps, elbows and similar parts the molding of which by this method is considered. GN (3)

Processing of Molding Devices for Mass Production (Die Herstellung von Formeinrichtungen für Massenartikel) *Zeitschrift für die gesamte Giessereipraxis,* Vol. 54, June 4, 1933, pages 229-231. The paper shows how simple devices may effectively increase the production when expensive labor saving machinery is not available. GN (3)

Report on Routine Methods for Testing Green Sands. *Foundry Trade Journal,* Vol. 49, July 27, 1933, pages 49-52; Aug. 3, 1933, page 68; discussion, Sept. 7, 1933, pages 136-37. A report by the Sands and Refractories Sub-Committee of the Institute of British Foundrymen, accompanied by 12 diagrams and concluding with 2 appendices—(1) on the determination of permeability in green molding sands by the A.F.A. standard method, and (2) on the determination of permeability in Richardson's apparatus. The method recommended by the Committee for moisture is that known as the "Speedy" (Brit. Pat. 33985), which depends on mixing a weighed quantity of sand with powdered calcium carbide in a closed container and reading the pressure generated through the liberation of acetylene gas. Dimensions of test pieces for determining both permeability and bond strength are discussed, but the most desirable type of test piece is not decided upon. A satisfactory relationship has been found between permeability and bond strength when using the different test pieces. The Committee conclude that permeability may be satisfactorily measured by the A.F.A. standard apparatus, Richardson's modification, or the B.C.I.R.A. apparatus—preferably the modified design for use in foundries with no gas supply. Bond strength should be determined by compression test. OWEp (3)

Sweep Molded (Loam Molded) Mixing Vessel [Ein Mischkessel nach Schablone (Lehmform)] *Zeitschrift für die gesamte Giessereipraxis,* Vol. 54, Nov. 26, 1933, pages 497-499. Detailed discussion of molding practice with special reference to procedure followed in pattern making. GN (3)

Suggestion of a Unification of the Testing Methods of Foundry Sands (Proposte d'Unificazione dei Sistemi di Prova delle Sabbie di Fonderia) V. S. Prever. *L'Industria Meccanica,* Vol. 15, May 1933, pages 415-418. Testing methods are divided into those for clay-containing sands and sands without clay. Methods of sampling, and determination of aging, cohesion and permeability are treated. Ha (3)

Molding of an Air Compressor Cylinder (Die Herstellung der Form für einen Luftkompressorzylinder) G. Schuele. *Die Giesserei,* Vol. 20, Oct. 27, 1933, pages 485-487. Complete description of procedure. Hap (3)

Effect of Silt on the Bonding Strength of Sand. H. Ries & R. C. Hills. *Transaction American Foundrymen's Association,* Vol. 41, 1933, pages 158-166. An increase in silt content of a sand lowers its compressive and tensile strengths. Coarse-grained sands are more susceptible to effects of silt than fine-grained sands. CHLp (3)

The Design of Castings (Il Desegno dei Getti) R. Comina. *L'Industria Meccanica,* Vol. 15, July 1933, pages 529-533; Aug. 1933, pages 614-620; Sept. 1933, pages 671-675. Conditions for obtaining good, sound castings, reasons for formation of pipes and holes, design and arrangement of molds to avoid them, pouring methods and temperatures are discussed. Many examples are given showing proper molding and sectioning. Proper organization of foundry as factor for economic operation is pointed out. Hap (3)

Molding of Pulleys (Formen von Riemenscheiben unter Verwendung von Genauigkeitsnaben) R. Wagner. *Zeitscrift für die gesamte Giessereipraxis,* Vol. 54, Sept. 17, 1933, pages 393-394. After discussing the difficulties in obtaining accurate hubs on pulleys made with wooden patterns author describes a new method which permits making 6000 different sizes of hubs with only 15 different hub parts and 17 different core prints. Instead of wood Al was used for the hub patterns so that former inaccuracies in dimensions were eliminated. GN (3)

Practical Pattern Plate (Eine praktische Modellplatte) *Zeitschrift für die gesamte Giessereipraxis,* Vol. 54, Nov. 12, 1933, pages 462-463. Description of a pattern plate meeting the following requirements (1) cheapness of manufacturing (2) high durability. The plate is subdivided in sections that can be easily interchanged. For each molding machine one molding frame in which the parts to be used for a certain work piece are inserted, is sufficient. Device described is made by Modell-und Maschinenfabrik Wallau/Lahn, Germany. GNp (3)

Casting Through Sieve Cores (Giessen durch Siebkerne) *Zeitschrift für die gesamte Giessereipraxis,* Vol. 54, Dec. 24, 1933, page 530. By pouring through "sieve" cores foreign materials are separated from the metal. Processing of sieve cores is briefly outlined and their use is discussed. GNp (3)

Modern Molding Machines (Neuzeitliche Formmaschinen) *Die Giesserei,* Vol. 20, Mar. 3, 1933, pages 94-96. A number of machines and parts are described and illustrated. Hap (3)

Cylinder Molds Are Skin Dried. *Foundry,* Vol. 61, Apr. 1933, pages 17, 48. To insure against sand not conforming to specifications entering the flasks, resulting in a number of scrap castings, the Studebaker Corporation foundry black washes and skin dries the drag face of all cylinder molds before placing the cores. Describes equipment and method used. VSPp (3)

Continuous Molding Machine Aids Production. *Iron Age,* Vol. 131, Apr. 20, 1933, page 628. Describes a foundry set-up consisting of a continuous conveyor in form of an oval, automatic molding machine, pneumatic vibrator, and conveyors and equipment for conditioning sand at Cleveland works of Westinghouse Electric and Manufacturing Co. VSPp (3)

Non-Ferrous (3a)

G. L. CRAIG, SECTION EDITOR

Remelting of Foundry and Machine Shop Scrap in Aluminum Foundries (Das Umschmelzen schwieriger Giesserei- und Gussputzereiabfälle in der Aluminiumgiesserei) R. THEWS. *Die Metallbörse,* Vol. 23, Mar. 4, 1933, pages 277-279. Al scrap is divided into 2 groups principally on account of the size involved: (a) gates, risers, sprues, etc., from the foundry and (b) chips and drillings from machining. Thews pointing at American practice, sees no objections against employing 25-30% of (a) even for making high-grade Al-alloys and contradicts the necessity of using virgin metal exclusively. Difficulties however arise when remelting scrap from drilling, sawing and planing operations. The removal of Fe by magnets, of moisture and oil by drying at 400°-450° C. (drum furnace) is considered. To eliminate oil, by centrifugal or chemical means is not justified by later losses during melting. The writer is strongly opposed to briquetting. The following melting procedure is urged: 15-25 kg. heavy scrap is melted first in the coke-fired crucible. Al-chips are stirred into the super-heated melt until the latter becomes thickly viscous. After raising the temperature, further chips are added, etc. The oxide layer is not to be removed too often. Contrary to American practice a scorifying $NaCl/CaF_2$ mixture with 15-30% CaF_2 is strongly recommended. For pure Al, 15% CaF_2 are sufficient. Instead of this oxide-scorifying treatment, stirring in of 0.50-0.75% Zn-chloride can be accomplished shortly before pouring. Reasonable time must elapse to allow the contaminations to ascend to the surface. After using the salt mixture mentioned above, the temperature of the crucible provided with a tightly fitting lid, should be raised to 780°-815° C. No reducing agent (coke, charcoal) should be used to avoid the absorption of the resulting gases. The favorable temperature control in gas and oil fired furnaces during melting down the scrap is pointed out. No super-heating of the first 30-40 kg. heavy scrap is then required. Stirring in of the chips results in mechanical removal of oxide films on the small particles. The additions are made at 680° and 670° C. should prevail at the end of each successive stirring in. After the last addition, the hermetically sealed pot is heated to 750° C. (800° max.) and treated with 0.5-1.0% Zn chloride. The rather dry layer on the surface of the metal is removed. In case of continuous operation, 30-40 kg. liquid metal should be always left in the crucible. Very finely sized chips heavily contaminated and containing non-metallic inclusions should be forwarded to chemical plants for preparing Al-salts. If this is not possible, an intimate mixture of the chips with 85/15 $NaCl-CaF_2$ is placed into an empty, super-heated pot. Further additions are made after melting. EF (3a)

Prevent Segregation in Bronze. JAMES BRINN. *Foundry,* Vol. 61, June 1933, pages 41-42, 81. Alloys high in Pb are particularly subject to Pb segregation, while ordinary red brasses and bronzes show little or no tendency toward it. Castings made from 80% Cu, 10% Sn and 10% Pb bearing bronze are free from segregation if the metal is stirred properly before pouring and if alloy is free from impurities. Segregation becomes less and less pronounced with increasing amount of added Ni. P retards Pb segregation in plastic bronze. Occasionally segregation appears in yellow brass even if composition is correct. Sn and P segregate but instead of concentrating in the center, they migrate to the surface of castings, forming "tin sweat." The hotter the casting is poured the more pronounced is the average segregation. VSPp (3a)

Melting and Casting High Lead Copper Alloys (Schmelzen und Giessen bleireicher Kupferlegierungen) WERNER FRÖLICH. *Chemiker-Zeitung,* Vol. 57, Sept. 20, 1933, pages 741-742. For alloys containing more than 20% Pb the lowest possible pouring temperature and quick cooling are necessary to prevent segregation. The addition of some Sn or Ni is helpful as they lower the melting point. The addition of P is harmful. Stirring the metal with a stick of S or galena reduces segregation of Pb. Na_2SO_4, NaCl, or .5-1.5% Zn are used for deoxidation. Ternary alloys containing 5-7% Sn are more homogeneous. Other alloys contain 2% Sn with or without 1% Ni. Ni also improves the mechanical properties. The Ni should be added in the form of 25% Ni-Cu alloy. CEMp (3a)

Use of Preheated Air in Smelting in Water-Jacketed Furnaces (L'Emploi de l'Air Chaud dans la Fusion des Minerais au Water-Jacket) B. BOGITCH. *La Technique Moderne,* Vol. 25, July 1933, page 503. Abstract from a note before the "Académie des Sciences." Experiments have been made with two furnaces of 40 ton and 100 ton capacity respectively using air preheated in calorised Fe tubes. Several thousand tons of nickel ore have been thus smelted. Vertical position of heating-tubes is promising for preventing rapid dust accumulation. Electrical firing up device is preferable. Hearth must be made of very refractory material (chromite). Moisture in ore must be less than 12-13%. The air temperature is between 300° C. and 650°C. and coke saving would vary from 1/10 up to 1/5 of the normal consumption. FR (3a)

Casting of Bearings and Bushings (Das Aus- und Umgiessen von Lagerschalen und Büchsen) ERICH BECKER. *Zeitschrift für die gesamte Giessereipraxis,* Vol. 54, Nov. 26, 1933, pages 491-493; Dec. 10, 1933, pages 512-513. Discusses methods for casting linings to avoid cracks, blowholes, etc. and secure a good bond. Preparation of bearing backs to receive different types of linings is discussed. Casting devices are described, melting procedure is outlined. Special precautions are required in casting bearings of red brass or bronze respectively. GNp (3a)

Aluminium Melting Losses. WILLIAM ASHCROFT. *Metallurgia,* Vol. 9, Dec. 1933, pages 42 and 52. Factors that influence loss are discussed. Furnaces are described. JLGp (3a)

Bronze Casting Practice (La Pratique de la Fonderie de Bronze) M. DETOURMIGNIES. *Revue de Fonderie Moderne,* Vol. 27, July 10, 1933, pages 189-196. A general discussion of properties, compositions, melting methods, pouring and treatment of bronze (Cu-Sn) alloys and the like with additions of P and Pb. Hap (3a)

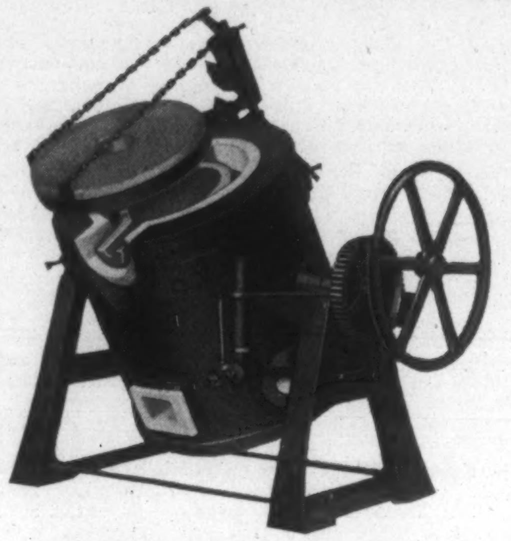
Influence of Melting Loss upon the Cost of Copper Alloys (Influence de la Perte au Feu sur le Prix de Revient des Alliages Cuivreux) A. BRIZON & G. D'ARDIGNY. *Revue de Fonderie Moderne,* Vol. 27, Aug. 25, 1933, pages 231-232. Back scrap consists of gates and risers, rejects, fins, grindings, etc. Actual losses come from oxidation and evaporation; the latter depends on composition of charge, temperature of melting, quality of materials (new or scrap), rapidity of melting, and kind of furnace and furnace atmosphere. These various influences are discussed and illustrated numerically. Ha (3a)

The Influence of Volatile Chlorides on Magnesium and on Copper. J. D. GROGAN & T. H. SCHOFIELD. *Engineering,* Vol. 135, June 23, 1933, pages 675-676. From paper read before the Institute of Metals, Mar. 1933. See *Metals & Alloys,* Vol. 4, Oct. 1933, page MA 334. LFM (3a)

Melting of "Elektron" Alloy from Magnesium Produced by a Soviet Magnesium Plant. P. S. MAIBORODA. *Tzvetnuie Metallui,* Mar. 1933, pages 374-377. (In Russian.) Describes some difficulties encountered in melting "Elektron" made from Soviet manufactured Mg, and means of overcoming the difficulties. BND (3a)

Refining of Lead by Chlorination. F. M. LOSKUTOV. *Tzvetnuie Metallui,* Sept. 1932, pages 87-98. Experiments to compare chlorination with fire refining of Pb. Under the conditions used the chlorination process showed little superiority, but some improvements suggested may increase its advantages. BND (3a)

Copper Wire Scrap. R. G. AREND. *Engineer,* Vol. 156, July 21, 1933, page 71. Copper wire comes under the category of scrap only when it cannot be reclaimed in the form of wire. The first step in the process of reclamation is bundling to a compact condition. Then the insulation or other covering is burned off and the scrap melted under oxidizing conditions to remove impurities. Refining process used is similar to that used in refining copper in general. LFM (3a)



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Progress in Casting Silumin (Fortschritte auf dem Gebiete des Silumingusses) G. Sachs. *Aluminium,* Vol. 15, Aug. 15, 1933, pages 1-4; Aug. 31, 1933, pages 1-5. The most used silumin compositions and their properties are tabulated and illustrations of uses as motor housings, doors, grates, fans, etc., given. Properties of castings cast in ingot molds are superior to those of sand-cast pieces. Ordinary silumin contains 13% Si 87% Al, copper-silumin 12% Si, 0.8% Cu, 0.3% Mn, beta silumin 12% Si, 0.3% Mg, 0.45% Mn. These alloys are well suited for die-casting. Hap (3a)

Some Notes on Phosphor-Bronze. R. C. Stockton. *Metal Industry,* London, Vol. 43, Oct. 20, 1933, pages 391-392. Most frequent defects in P-bronze castings are porous appearances of machined surfaces due to contraction cavities formed during solidification, "drawn" parts, particularly near runners and risers, gas holes and included oxides; they are directly attributable to either incorrect casting temperature, bad arrangement of gates and risers, bad molding and melting practice and sometimes to faulty design of patterns and castings. These reasons are discussed in detail and correct arrangements shown. Hap (3a)

The Vertical Centrifugal Casting of Non-Ferrous Alloys. A. R. Stockton. *Metal Industry,* London, Vol. 43, Aug. 4, 1933, pages 97-98. Advantages of centrifugally cast over sand or chilled cast non-ferrous metals are summarized as follows: lower coefficient of friction, greater resistance to wear, increased hardness, higher maximum stress, slightly increased density, greatly reduced grain size, freedom from porosity or gas holes, greater resistance to compression stresses and reduction in production cost. This is exemplified by Ni-P-bronze gears and worm wheels. Hap (3a)

Removal of Gases and Other Impurities from Aluminum and Its Alloys by Means of Aluminum Chloride in Connection with Other Salts (Entfernung von Gasen und anderen Verunreinigungen aus Aluminium und seinen Legierungen mit Hilfe von Aluminiumchloride in Verbindung mit anderen Salzen) Steinhaeuser. *Aluminium,* Vol. 15, June 30, 1933, pages 1-3. See *Metals & Alloys,* Vol. 4, Dec. 1933, page MA 392. Hap (3a)

Making of Pulping Machine Knives of Phosphor Bronze (Herstellung von Holländer-Messern aus Phosphorbronze) *Zeitschrift für die gesamte Giessereipraxis,* Vol. 54, Dec. 10, 1933, pages 511-512. Discussion of production of such pieces as are best cast in sand in single pieces, then cold worked and hardened. Casting in Fe molds is not advisable. Pure raw materials should be used. Great care is required in melting. Making of mold is considered. Hap (3a)

Use of Mixed Brass Scrap (L'Utilization des Déchets de Laiton mélangés) *Cuivre et Laiton,* Vol. 6, Feb. 28, 1933, pages 98-99. In order to eliminate the difficulty of obtaining an exact composition because the composition of the brass scrap is not known or uniform, a method used by a large company for making a quick analysis of the scrap is described. Hap (3a)

Castability of Ternary Alloys. A. Portevin & P. Bastien. *Journal Institute of Metals,* Vol. 53, Dec. 1933, pages ccxxxvi to ccxlvii, Paper No. 654. "Castability" is defined as the ability of a metal or alloy to fill a mold completely. Tests with a spiral mold indicated that castability was a linear function of the difference between pouring temperature and melting point. Castability was measured as the length of the spiral mold filled. The shape of the curve castability against pouring temperature varies with the viscosity. The castability of binary and ternary alloys varies with the solidification range and the type of crystallization. Castability curves for Al, Zn, Sb, Cd, Pb, and Sn are shown. Diagrams for the castability of series of alloys of Sb-Pb, Sb-Cd, and Sn-Pb-Bi are shown. Peaks in castability are found at eutectic points. Castability offers a method for determining solidification diagrams and for choosing the most suitable casting alloy. 13 references. JLGp (3a)

How to Make Sound Aluminum Bronze Castings (Wie stellt man einwandfreien Aluminium Bronzguss?) E. T. Richards. *Zeitschrift für die gesamte Giessereipraxis,* Vol. 54, Oct. 1, 1933, pages 411-412; Oct. 15, 1933, pages 429-431. Discussion of precautions to be observed in the melting and casting of the commercial aluminum bronzes. GN (3a)

Desulphurization of Nickel Matte in the Induction Furnace. V. Zakharov. *Tzvetnuie Metallui,* Dec. 1932, pages 50-52. Experiments indicated that desulphurization of Ni matte can be accomplished by blowing the matte in an induction furnace, or simply by passing air stream over the surface of the melt. The S was reduced to 0.5-0.3%. It is believed that the desulphurization can be carried further if a suitable crucible lining material be found. The author used crucibles lined with zirconia or magnesite, or graphite crucibles lined with magnesite or magnesite and tar. None of these, however, lasted more than 2-3 hours at the melting temperatures. BND (3a)

Melting of Zinc in Ajax Induction Furnaces. P. A. Zakharov. *Tzvetnuie Metallui,* May-June 1932, pages 66-68. Experiments showed that 300 to 600 kg. charges of Zn can be melted without superheating or volatilization using 220 volts and 620 amps. The loss in melting (1%) was found to be considerably less than in melting in crucible, reverberatory or other types of furnaces (3-4%). A study of the structure of melts of Zn with addition of Pb and Cd showed a very uniform distribution of these additions which is attributed to the self stirring of the molten charge in the induction furnace. BND (3a)

A Few Problems in Non-Ferrous Castings. Georg Masing. *Metals & Alloys,* Vol. 4, July 1933, pages 99-104; Aug. 1933, pages 109-113. Abstract of a lecture at Carnegie Institute of Technology. Shrinkage and piping and direct and inverse segregation are discussed. The various theories of segregation are discussed at length. Diagrams and tables of shrinkage, segregation and density are given. Part II. Discusses gases in Y-alloys, 4% Cu, 2% Ni, 1½% Mg, balance Al. WLC (3a)

Monograph on the Sands for Foundry Use (Monografie sulle Tierre e Sabbie nazionali per Fonderia) *L'Industria Meccanica,* Vol. 15, Mar. 1933, pages 227-232. Chemical and physical characteristics of sand deposits at Biella (Italy), preparation for foundry purposes and treatment are described. Ha (3a)

An Electrolytic Copper Refinery. *Engineer,* Vol. 156, Aug. 18, 1933, pages 153-155. Lengthy description of the new completely electrified plant of Canadian Copper Refiners, Ltd., at Montreal. It is the first copper refinery in the Province of Quebec. Its capacity is 75,000 tons per year, the product to be largely consumed by the electrical industry. LFM (3a)

Copper Embrittlement, III. L. L. Wyman. *American Institute Mining & Metallurgical Engineers, Technical Publication* No. 508, Oct. 1933, 11 pages. Deoxidized coppers were heated in an oxidizing atmosphere, then in a reducing atmosphere at different temperatures, and the depth of the embrittled layer determined by microscopic examination. Tough-pitch coppers were heated in a reducing atmosphere at various temperatures and for as long as 4 hrs. Neither pure Cu, oxidized or deoxidized, nor tough-pitch Cu containing as much as 0.06% O was embrittled by H_2 at temperatures up to 400° C. The rate of O penetration into pure Cu decreased markedly below 800° C. Into O-bearing Cu it decreased markedly below 700° C. Up to 800° C. Cu containing no O is superior to O-containing Cu. The rate of embrittlement or deoxidation due to H_2 decreases with the depth of penetration. JLG (3a)

Widening Scope of Aluminum Permanent Mold Castings. Harry L. Smith, Jr. *Iron Age,* Vol. 131, Feb. 23, 1933, pages 312-313, 340. Fine grain structure of permanent mold casting and the freedom from more common foundry defects, insure maximum physical properties that can be obtained in any type of Al alloy casting. Dimensional accuracy of permanent mold castings is midway between sand castings and that of pressure die castings. Machining may be reduced below that required for sand castings. For many purposes machining may be eliminated. Considerable progress has been made in casting intricate shapes such as parts for teletype machine and complicated cooking utensils. Includes table giving the properties of some of the more common Al permanent mold alloys. VSP (3a)

Notes on Casting Under Pressure (Généralités sur la Coulée sous Pression) A. Brizon & G. D'Ardigny. *Revue de Fonderie Moderne,* Vol. 27, July 25, 1933, pages 205-211; *L'Usine,* Vol. 42, June 2, 1933, page 29. The different methods for producing pressure in die-casting, i.e. (1) by plunger, (2) by compressed air, (3) by vacuum, and different kinds of equipment are discussed and described for die-casting of Pb, Sn, Zn and Al. The advantages are mainly: great saving in space and labor and good uniformity of production. Although investment cost and amortization are high and tools expensive these charges are often counterbalanced by avoidance of machining. Hap (3a)

Deoxidation of Copper Alloys (Ueber die Desoxydation von Kupferlegierungen) H. Nipper. *Die Giesserei,* Vol. 20, Mar. 17, 1933, page 112. The individual stages of the deoxidation process under the influence of the alloying elements Zn, Sn and Al are discussed; the vapor pressure in the melt, content of gases, distillation products of the fuel, fluidity of the bath, all have an important influence. Hap (3a)

Metal Mixing by Analysis. Wesley Lambert. *Metal Industry,* London, Vol. 42, Apr. 28, 1933, pages 441-442. The economy of a foundry depends considerably on the utilization of scrap metals. It is, therefore, necessary to make careful analyses for mixing the metals in proper proportions to obtain the desired product. The method of calculating metal mixings by analysis necessitates the making up of a table for (1) the weight of each parcel of metal comprising a charge, and (2) the actual amount of each constituent metal introduced into the charge. An example illustrates the method and advantages derived from it in the operation of a foundry. Hap (3a)

Melting and Molding of Bronzes in Green Sand (La Fusion et le Moulage du Bronze à Vert) G. D'Ardigny. *Revue de Fonderie Moderne,* Vol. 27, June 25, 1933, pages 184-186. The advantages claimed for molding and casting of bronze in green sand are that pieces can be made in this way which cannot be made in dried molds; further, elimination of stoves and the attendant waiting for molds to be dried results in saving of space and time, reduction of labor and other incidental costs, quicker delivery and better castings which need less cleaning. Hap (3a)

Aluminum-Bronze Parts Cast in Permanent Molds. E. Griffith. *American Machinist,* Vol. 77, Sept. 27, 1933, pages 616-617. Al-bronze parts are cast in heated molds at 2200° F.; sharp corners in the molds must be avoided. The mold is preferably made of high test cast iron. Properly made molds save machining of the casting. General directions for laying out molds and handling castings and metal are given. Hap (3a)

Electric Melting and Annealing Furnaces in the Plant of Hirsch Copper & Brass Co. (Elektrische Schmelz- und Glühöfen im Betriebe der Hirsch Kupfer- und Messing werke A.-G., Finow) Thos. Metzger. *Elektrowärme,* Vol. 3, July 15, 1933, pages 199-208. Capacity of the plant is 3000-4000 t. of sheets, pipes, wires, rods, shapes of German silver, Cu, pure Ni and special bronzes. All Cu-Zn alloys are hot-rolled; Ajax-Wyatt induction furnaces are used for melting of Cu and its alloys with Zn and Ni-Zn; water-cooled ingot molds are used. 21 induction furnaces of 120 kw. each produce brass ingots of 600 kg. 40 electric furnaces totalling 5000 kw. are in operation for pipes up to 7m. length, sheets of 600 mm. width up to 1.2 mm. thickness, bolts, fittings, etc. 4 muffle furnaces of 165 kw. each serve for annealing small strips and sheets and 8 muffle furnaces for annealing of brass slabs. A continuous furnace for 80 kw. for brass strip consumes 100-160 kw. hr./ton material at 720° C. The whole installation is described and illustrated. Ha (3a)

Science Perfects Bell Making. J. B. Nealey. *Foundry,* Vol. 61, Feb. 1933, pages 17, 58. Discusses bell founding by the E. W. Venduzen Co., Cincinnati. Bells are made from alloy of Cu and Sn. Standard composition of swinging bells is 80% Cu and 20% Sn, while in stationary bells the composition is around 78% Cu and 22% Sn. Two major factors in bell design, aside from metal composition, are shape of the bell outline and thickness, which varies with the curve of the bell. VSP (3a)

The Electrolytic Refining of Mercury. E. Newbery & S. M. Naude. *Metal Industry,* London, Vol. 43, Oct. 27, 1933, pages 415-418. The absolutely pure Hg required for some industrial processes and instruments is prepared by an electrolytic process. The electrolyte is mercurous perchlorate, the anode is the Hg to be purified, and the starting cathode is stainless Fe or Pt. The difficulties of the process are discussed in detail and the mechanical equipment described. Spectrographic test proved the deposited Hg to be chemically pure. Ha (3a)

Magnesium: Metallurgy and Founding (Le Magnesium: Metallurgie et Fonderie) Paul Bastien. *Bulletin de l'Association Technique de Fonderie,* Vol. 7, Oct. 1933, pages 383-390; *L'Usine,* Vol. 42, July 20, 1933, page 31. Mg alloys are melted in Fe or steel crucibles. Fluxes are usually chlorides or fluorides of Mg and alkali metals or alkaline-earths. The alloying metals are added directly to the molten Mg in most cases. A reducing atmosphere may be obtained by having a cloud of S around the gate. In green sand molds S or boric acid may be incorporated in the sand to produce an inert atmosphere in the mold. Argon is used in chill mold and extrusion processes. Properties of various Mg alloys are given. 7 references. WHS + Ha (3a)

Technical Problems in Casting Aluminum (Giessereitechnische Fragen beim Giessen von Aluminium) J. Dornauf. *Zeitschrift Verein deutscher Ingenieure,* Vol. 77, Sept. 2, 1933, pages 941-945. Molding and casting technique, although in principle the same as for Cu and Fe, require some special arrangements. The mold must be quite permeable on account of the low density of Al, in order to let the gases produced in casting escape from the mold. Experiments with green and dry sand molds showed the strength of specimens cast in dry sand always to be about 2-3 kg./mm.^{2} higher. The arrangement of gates and risers is also of great importance; correct and incorrect arrangements are shown. Al is melted best in a coke crucible furnace with natural draft with dry coke free of S. But as this type of furnace requires special attention to avoid overheating of the metal, forced draft is often used or, for charges of more than 200 kg., hearth type furnaces heated by oil, coke or electricity. Coke is preferable if no electric current is available. Results of melts made in different furnaces are given, high values of strength and elongation were always realized. AIK+Hap (3a)

The Copper Refinery at Prescot. D. W. Aldridge. *Metal Industry,* London, Vol. 43, Dec. 22, 1933, pages 605-608; Dec. 29, 1933, pages 631-633. Layout of plant, buildings, equipment, processes, etc., are described fully. Hap (3a)

Centrifugal Casting of Non-Ferrous Metals (La Coulée Centrifuge des Metaux non Ferreux) Dubercet. *Revue de Fonderie Moderne,* Vol. 27, Jan. 25, 1933, pages 17-21. The practice and methods of centrifugal casting of non-ferrous metals are discussed and a few casting equipments described and illustrated. Hap (3a)

On the Production of Iron-Poor Remelted Zinc. E. R. Thews & W. E. Herrmann. *Metal Industry,* London, Vol. 42, May 5, 1933, pages 465-467. The removal of Fe from Zn remelted from Zn-scrap is discussed both with regard to removal from mechanical impurities contained in the scrap and to prevent Fe from being absorbed from the melting appliances during the remelting process. This absorption seems to be most pronounced in the reverberatory furnace process where the Zn-scrap contains much mechanical Fe, but as this is the only source of Fe in this type of furnace it is most suitable for economical remelting if Fe-free scrap can be provided. Melting pot furnaces are, however, cheaper for small scrap remelting with Fe contents of 0.1-0.15%. The maintenance of a neutral or slightly oxidizing atmosphere above the melting point is advisable. The loss of Zn by oxidation is held rather imaginary. The noxious vapors developed by scrap, particularly in melting pots, are often due to insufficient stack section. Making the stack area large enough will eliminate this nuisance. Hap (3a)

Ferrous (3b)

C. H. HERTY, SECTION EDITOR

Improvement of the Quality of Open Hearth Steels (Zur Frage der Qualitätssteigerung von Martinstählen) WALTER SCHÖNBURG. *Die Metallbörse,* Vol. 23, Aug. 12, 1933, pages 1021-1022. A more uniform quality of open-hearth steels is urged with the object of saving weight. The expensive, effective but mostly impure deoxidizers Fe-Mn, Fe-Si and Al are abandoned more and more. Pig Fe high in Mn is best suited. A highly pure steel running higher in Mn and containing no alloying elements besides Cu is a recent trend in Germany. The melting operation starts with no or a low addition of lime. The Fe and Mn oxides readily enter the rather fluid more acid slag which assumes a basic character later resulting in reentering of Mn into the melt which is supported by the reaction of C and O_2 in the bath. Thus a continuous, automatic Mn reduction without any additional deoxidizer is assured, a longer melting period presumed. The higher impact values ascribed to the improved degree of purity are stressed. EFp (3b)

Some Notes on the Basic Open Hearth Process. *Iron & Steel Industry & British Foundryman,* Vol. 6, May 1933, pages 275-276, 279. Fluorspar in open hearth slag aids dephosphorization. Lime-spar slags are efficient deoxidizing media. Steel practice in England does not favor a high residual Mn. The soundness of ingots is a function of the Brinell T value and the size of the mold. The method of adding Mn and Si does not alter the Brinell T value but it affects the non-metallic inclusion content of the steel. CHL (3b)

The Carburization of Cast Iron and Steel Scrap by Charcoal, Coke, Graphite and Petroleum Coke (Ueber die Aufkohlung von Gusseisen- und Stahlschrett durch Holzkohle, Koks, Graphit und Petrokoks) H. NIPPER & E. PIWOWARSKY. *Die Giesserei,* Vol. 20, July 7, 1933, pages 277-280; abstract, *Foundry Trade Journal,* Vol. 49, Sept. 14, 1933, page 152. Carburization experiments with mild steel and low C cast iron in the melting crucible showed the best result with petroleum coke, and then with coke and charcoal decreasing in the order named. Carburizing effect of graphite depends on size of pieces and its structure and purity. Micrographs illustrate the structure of the steel and Fe. OWE + Hap (3b)

Making Alloy Irons in the Jobbing Foundry. *Iron & Steel of Canada,* Vol. 16, July-Aug. 1933, pages 89-90. Description of methods employed in foundry of Darling Brothers, Ltd., Montreal, in production from cupola of high-test irons of various types. OWE (3b)

Heterogeneity of Steel Ingots. *Iron & Coal Trades Review,* Vol. 127, Oct. 6, 1933, pages 524-525; Oct. 13, 1933, page 554. A review of present possibilities of analytical determinations of inclusions in steel ingots; testing method of determining total O content, CO, CO_2, H_2, oxides and microscopical examination of samples are discussed. Standardization of sample-taking and testing is recommended in order to arrive at complete elucidation of reasons for metallic and non-metallic inclusions. Ha (3b)

Steel Castings. *Engineer,* Vol. 155, Apr. 28, 1933, page 424. Describes castings made in the Letchworth, England plant of Kryn and Lahy. As much as 90% scrap is used provided the scrap is of the proper composition. The steel possesses excellent properties and contains 0.30% C, 0.35% Si, 0.8% Mn, 0.04% S, and 0.05% P. Particulars are given of the various processes used. LFM (3b)

Production and Heat Treatment of Austenitic Manganese Cast Steel (Herstellung und Wärmebehandlung austenitischen Manganstahlgusses) *Die Metallbörse,* Vol. 22, Oct. 29, 1932, pages 1390-1391. Discusses the Guillet diagram showing the effect of C and Mn upon the microstructure of Mn-steels. Mn usually runs between 10 and 14% and C from 1.3-1.25%. Higher C contents increase the tendency towards cracking during heat treatment. Si above 1% improves casting properties and resistance to wear (1.75% Si). S is 0.04% max. and no harmful effect of P was noticed up to 0.125%. Mn steel is most advantageously made in basic electric furnaces from 80% ferro-manganese and open hearth or Bessemer steel. The brittleness of the castings which is due to the presence of free cementite and the conversion of austenite into troostite and martensite is overcome by heating to 1040°-1060°C. and subsequent water quenching. Too high casting temperatures result in a loss of 10.5-14 kg./mm.^{2} tensile strength. Casting just above the solidification point is urged. The mold of thin walled castings which necessarily require higher pouring temperatures must be designed in such a manner as to use the lowest possible casting temperatures. EF (3b)

Control Features Steel Foundry. FRANK G. STEINEBACH. *Foundry,* Vol. 61, Feb. 1933, pages 20-22, 60-61. Describes the supervision of all materials from the time received at the foundry of the Detroit Steel Casting Co. until the finished product. Standards for materials and practices permit production of plain C and alloy steel castings adequate for a wide variety of engineering services. Suggestions, from the proper design of steel castings to shipment of finished product, are given individual attention. VSP (3b)

Continuous Production of Cast Iron Brake Shoes and Similar Products (Fliessanlage für die Herstellung von gusseisernen Bremsklötzen und ähnlichen Erzeugnissen) W. RUDOLPH. *Die Giesserei,* Vol. 20, Nov. 10, 1933, pages 500-503. Describes equipment and layout of the plant. Hap (3b)

Management Policies and Practice in a Continuous Production Gray Iron Foundry. W. G. REICHERT. *Transactions American Society of Mechanical Engineers,* Vol. 55, Apr. 30, 1933, pages 43-48. An investigation into the essentials for efficient management of a continuous-production foundry lead the author to the statement that maximum efficiency as measured by the cost of production can be obtained only through scientific management; the example of a foundry for 250 tons daily capacity is given where the individual processes as melting, molding, coremaking, cleaning, and general expenses are treated fully. Hap (3b)

Pouring Technique (Eingusstechnik) J. PETIN. *Die Giesserei,* Vol. 20, Mar. 31, 1933, pages 125-127. Influence of arranging gates and risers in the mold on economy of the foundry is discussed. 3 groups are distinguished: (1) gates are arranged on the mold so that the liquid Fe goes into the mold by gravity; this method will generally be applied for large thin-walled pieces. (2) The gate connects with the inside of the mold. The section is larger than the gate section. The Fe flows into the mold with retardation. Used for thick-walled castings. (3) As under (2) but the total section is smaller than the gate section. Fe enters with acceleration into the mold, successful for thin-walled castings as the molten Fe fills all corners well. Determination of gate sections and pouring times is illustrated by a few examples. Hap (3b)

Phenomena of Flow in Molds and Their Influence on Pouring Time (Ueber Strömungsvorgänge in Giessformen und ihren Einfluss auf die Giesszeit) KIRSTENPFAD. *Zeitschrift Verein deutscher Ingenieure,* Vol. 77, Nov. 11, 1933, pages 1221-1222. Quality of cast Fe depends on superheating of melt and pouring temperature, and especially on the time used for pouring. This time depends on the inner friction of the melt, i.e., its viscosity, exterior friction conditions and gas resistance. These 3 influences were investigated. The tests for determining the viscosity of a cast Fe of 0.09% S, 3.4% C, 1.65% Si, 0.9% Mn, 0.8% P, 93.16% Fe are described in detail; viscosity was found to be fairly low, of the order of about $8\text{-}26 \times 10^{-6}$ m.^{2}/sec. according to the speed of the melt; the low viscosity would also explain the good penetration of solders into the finest crevices. The formula developed for viscosity agrees well with the test results. Hap (3b)

Interesting Foundry Development at Eastleigh Works, Southern Railway. *Railway Engineer,* June 1933, pages 167-172. The installation of a new continuous casting plant ensuring rapid and accurate production of iron castings on a large scale is abundantly illustrated and described in full detail. WHp (3b)

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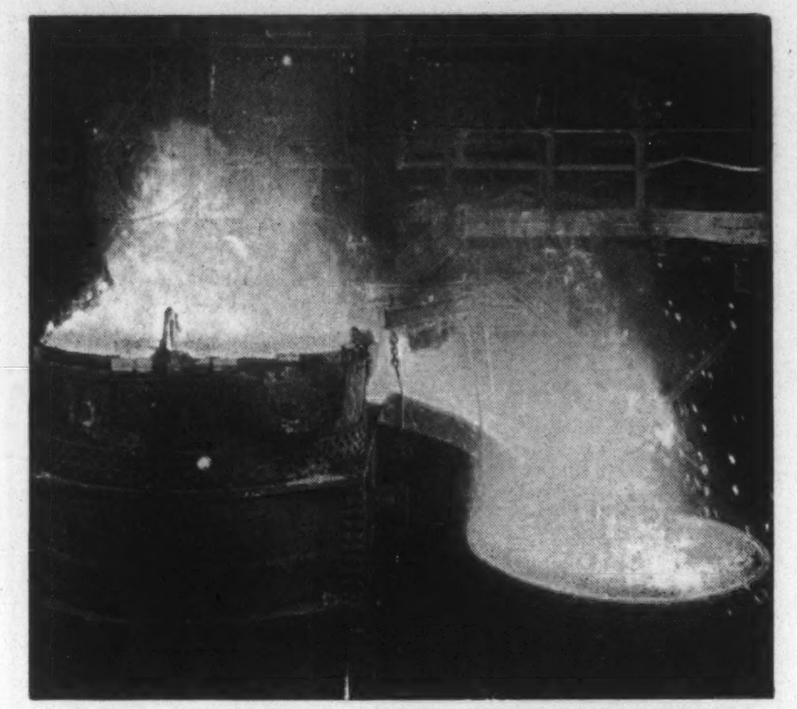

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Use of Manganese Ore in Comparison with High Manganese Pig Iron in Basic Open Hearth Charge (Versuche mit Manganerz im Vergleich zu Stahleisen im Einsatz beim basischen Siemens-Martin-Ofen) Report No. 256 of the Steel Works Committee of the Verein deutscher Eisenhüttenleute. *Archiv für das Eisenhüttenwesen,* Vol. 7, Aug. 1933, pages 81-87. Using 50% Mn ore in the charge enough Mn was reduced to raise the Mn content of the metal bath as high as when 5.6% Mn pig iron was used in the charge. The bath should melt down over 1% in C to effect this reduction; the more manganese ore, the more C, should be added. This practice resulted in a 20% saving in charge costs. SE (3b)

Core Assembly Handled as Unit. *Foundry,* Vol. 61, Aug. 1933, pages 10-12, 51. Core work, assembly and setting of unit for Packard engine block are described. Detailed account of various steps in casting entirely in core is given. VSP (3b)

"Pumping" in the Foundry (Le Pompage en Fonderie). Technical Committee of the Belgian Foundry Association. *La Fonderie Belge,* Vol. 2, pages 122-123. It is noted that by moving alternately, upwards and downwards, a metallic bar—heated to redness—in the liquid metal of a feeding head, a way is kept between the head and the casting allowing a better feeding of the latter. This method would act as follows: the bar is plunged into the upper part of the casting where it overheats then, when moved upwards in the feeding head it gives up its heat to the superficial skin which has a tendency to freeze first. With that process, the surface is kept liquid and it is possible to pour again hot metal in order to feed the shrinkage of the casting. The best results are obtained in the following conditions (1) Use very hot bar in order to prevent cooling of the head, (2) keep the bar clean; all the slag being removed from it, (3) at the beginning, dip the bar into the casting but when the pasty state is reached move the bar only in the feeding head, (4) move the bar all round the head for maintaining a liquid channel as large as possible, (5) at the beginning, add liquid metal at the same temperature as the casting but at last pour hot metal, (6) dispose the head on the heavy section of the casting, (7) avoid oscillatory stir of metal between two heads for preventing displacement of cores, (8) use head with cylindrical or conical shape but, in the latter case, dispose the larger end on the casting to prevent the freezing at the point of attack. FR (3b)

Study of Cupola Furnace Equipped with Small Tuyeres (Etude sur les Cubilots munis de petites Tuyères) G. Itam. *Revue de Fonderie Moderne,* Vol. 27, Sept. 10, 1933, pages 243-247. Experiments made with a reduced section of the blast-holes have given a better result with regard to uniformity of melting; the lining was less attacked, and the wind pressure varies less than with tuyeres of large section. The layer of coke remains almost horizontal, no hollow space or arch is formed and oxidation is reduced. Cooling starts much later, thus permitting more time for the hanging to reduce. Operating examples are described. Hap (3b)

Permanent Molds in Production of Crankshafts. *Iron Age,* Vol. 131, April 27, 1933, pages 665-666. First description of permanent mold casting of gray Fe by methods developed by A. W. Morris. VSP (3b)

Melting Points of Metallurgical Slags (Smälpunktsbestämningar a en del metallurgiska slagger) Axel Wejnarth. *Jernkontorets Annaler,* Vol. 117, Jan. 1933, pages 21-43. The melting points of a large number of ferrous silicates containing MnO, CaO, Al_2O_3, and MgO, have been determined by the electrical conductivity method. No relation was found between viscosity and conductivity, since the latter is both electrolytic and electronic, but with a high SiO_2 content, the large temperature co-efficients of conductivity indicate an increasing viscosity. Several tables and graphs are included. 15 references. HCD (3b)

Uses Insulated Covered Ladles. D. O. Thomas. *Foundry,* Vol. 61, Jan. 1933, pages 18-20, 53. Describes an insulated covered ladle used at the Saginaw Malleable Iron division of General Motors Corp. The ladle reduces the amount of super-heat required in electric furnace, due to eliminating the major part of the heat lost with the old type ladle. VSP (3b)

A Few Proposals for Application of Accuracy Hubs (Einige Vorschläge zur weiteren Verwendung von Genauigkeitsnaben) R. Wagner. *Zeitschrift für die gesamte Giessereipraxis,* Vol. 54, Dec. 10, 1933, pages 517-518. In supplementing his former paper (*Zeitschrift für die gesamte Giessereipraxis,* Vol. 54, Sept. 17, 1933, pages 393-394) on the use of accuracy hubs the author states that their use is not restricted to the making of pulleys. He shows how they are advantageously used in making gear and handwheel patterns or also for idle bushings. Other instances where they may be used are pointed out. Principal advantages are: saving of extensive molding devices, high accuracy of castings, etc. GN (3b)

Processing of Face Plates of Large Dimensions (Die Herstellung von Planscheiben grosserer Abmessungen) R. Uhlitzsch. *Zeitschrift für die gesamte Giessereipraxis,* Vol. 54, Dec. 10, 1933, pages 505-507. Detailed discussion of procedure followed in manufacturing a parted face plate, 8 m. in diameter. To achieve sound casting gates must be correctly dimensioned for attaining required high casting speed and high ferrostatic pressure, sufficient safety in loading the mold and a well melted iron. GN (3b)

Molding Stainless Steel Pelton Bucket Castings. H. V. Fell. *Iron & Steel Industry & British Foundryman,* Vol. 7, Oct. 1933, pages 3-5. General description of molding operation. CHL (3b)

Grey-Iron Castings. F. K. Neath & H. F. Poole. *Foundry Trade Journal,* Vol. 48, June 1, 1933, page 376. Extended abstract of a paper of general character, to which report of discussion is appended. OWE (3b)

Oxygen in Cast Iron. William F. Chubb. *Metallurgia,* Vol. 8, Aug. 1933, pages 125-126; Sept. 1933, pages 147-148; Vol. 9, Dec. 1933, pages 53-54. Discusses occurrence and detection of O in cast iron. Final chapter describes deoxidizers that have been used. JLG (3b)

Pours Steel Castings On Conveyors. Frank G. Steinebach. *Foundry,* Vol. 61, Jan. 1933, pages 10-12, 46. Describes method and equipment used by the Detroit Casting Company. VSP (3b)

Permanent Molds Speed Production. Frank G. Steinebach. *Foundry,* Vol. 61, May 1933, pages 10-12, 40, 42. Castings produced in permanent molds at the foundry of Delco-Remmy Corp'n, range in size from 1½ to 9 lb. and include starter housings, end bearings for generators, starters, etc. All molds are produced from a Ni-Cr gray Fe melted in a direct arc electric furnace and poured in dry sand molds. Face of each mold is coated with refractory material of clay and Na_2SiO_3. Two general types of molding machines used. One has its molds opened and closed automatically and makes castings requiring no cores, the other has molds which are opened automatically but closed manually. Temperature of the face mold must be maintained at approximately 400° F. Life of gray Fe mold depends on shape of castings being made. Two cupolas are used for melting. Conveying and handling equipment is used in all operations. VSP (3b)

Investigates Ternary Alloys for Deoxidizing Steel. *Steel,* Vol. 91, Nov. 7, 1932, pages 31, 33. Report on papers presented at 6th annual meeting of Metallurgical Advisory Board to Carnegie Institute of Technology, held jointly with Iron & Steel Division of American Institute of Mining & Metallurgical Engineers, Pittsburgh, Pa., Oct. 28, 1932. JN (3b)

Injection of Water in Steel Baths. (Das Einspritzen von Wasser in Eisenbäder bei der Stahlerzeugung.) *Technische Blätter der deutschen Bergwerkszeitung,* Vol. 23, July 2, 1933, page 368. In the briefly described new steel refining process patented by the Krupp Works, water is injected in the steel bath. The advantages of the process are enumerated. GN (3b)

Stainless Iron and Steel Production. *Engineer,* Vol. 153, June 17, 1932, pages 663-664; June 24, 1932, pages 702-703. **Stainless Steels are Firmly Established in Industry.** *Steel,* Vol. 90, May 23, 1932, pages 27-28. See "Stainless Production—Equipment and Method of Manufacture," *Metals & Alloys,* Vol. 4, Aug. 1933, page MA 261. LFM + JN (3b)

Melting of Sponge Iron in an Electric and an Acid Open Hearth Furnace in a German Plant. YA. GRANNIKOV. *Domez,* No. 7, 1933, pages 29-42. In Russian. Sponge iron is received compressed into cylinders containing 1.07 C, 0.6 SiO_2, 0.1 Mn, 0.01 P, 0.027 S. Cylinders often pulverized in storage. Charges of electric furnace contained up to 35% sponge iron, but usually it was kept around 10% because large amount of oxide uselessly oxidized other ingredients of alloy steels for which it was used. The quality of the metal produced in electric and acid open hearth furnaces was satisfactory. The operations were the same as when using scrap. Selection of sponge instead of scrap depends on economical considerations. Sponge cannot be charged directly on acid bottom. Several detailed melting sheets are given. (3b)

A Necessary Condition for Producing Slag Free Steel (Ett väsentligt villkor för erhallandet av slaggrent stal) C. BENEDICKS & H. LÖFQUIST. *Jernkontorets Annaler,* Vol. 117, Mar. 1933, pages 151-165. It is recommended that during the addition of Mn or other deoxidizing component to the Fe, that enough of the corresponding oxide be added to the slag bath so that the slag and the metal are in equilibrium. A phase diagram of the slag compositions in equilibrium with various steel compositions is given. 20 references. HCD (3b)

Nitrogen in Iron-Carbon Alloys. W. F. CHUBB. *Iron & Coal Trades Review,* Vol. 127, Aug. 4, 1933, page 171; *Foundry Trade Journal,* Vol. 48, June 22, 1933, page 431. Studies in recent years on the influence of gases in metals have fairly clearly established that N plays an important part in the behavior of Fe-C alloys in their manufacturing stages. 3 nitrides of Fe were found to exist in the equilibrium diagram, Fe_2N, Fe_4N and Fe_6N. Accurate methods of determining N in ferrous alloys, especially methods for routine work in steel works are not yet available as they are too cumbersome. Separation of N from Fe or steel can occur only after prolonged periods of heating at a relatively low temperature; heating to 100° C. for 14 days is stated to remove N completely. Amounts of 0.01% have been removed which is probably the limit of solubility of N in steels. The removal was accompanied by changes in physical and mechanical properties, in particular by an increase of magnetic coercive force and reduction of specific electric conductivity. Torsional strength was increased by about 25% of the original value. Recent work on this subject is briefly reviewed. OWE + Ha (3b)

Test Shows Cupola Melting Loss. M. J. GREGORY. *Foundry,* Vol. 61, May 1933, pages 18-20, 50. Concern is felt throughout the industry over the amount of metal that is reported as melting loss in various foundries. Melting losses often are from 2 to 12%. Large industrial plants will find a large amount of material that now is disposed of really valuable melting material. One automobile concern is combating this problem by buying up and reclaiming their obsolete motor cars. This material is reduced back into steel and pig Fe. Describes method used by the Caterpillar Tractor Co. in reclaiming its refuse. Gives table showing melting loss covering 26 days' operation. VSP (3b)

Cupola Practice for Malleable Iron. HERBERT H. FARR. *Foundry,* Vol. 61, Mar. 1933, pages 24-25, 60, 61. Discusses the theory and practice of cupola melting of malleable Fe. Excessive oxidation probably is the greatest evil in cupola melting. This may be caused by high wind pressure delivered through small blast pipes into and through tuyeres. If tuyere area is too small velocity of air is so great that penetration toward center of cupola will be too strong. Tuyeres should be so flared that inside openings will be nearly continuous around circumference of cupola. Coke should be dense, low in S and volatile matter and high in C. Continuous melting is described. Regulation of C is important. VSP (3b)

Produces Castings in Metal Molds. FRED ERB & EDWIN BREMER. *Foundry,* Vol. 61, June 1933, pages 38-39, 74, 76. Describes the application of permanent mold process to a variety of different types of gray Fe castings at the Eaton-Erb Foundry Co., Vassar, Mich. After several years of experimental work a type of mold was developed which involves the use of a large number of cooling pins about ⅝ in. in diam. and 2 in. long all over the backs of molds. Molds are heated to about 300 to 500° F. before being placed on machine. Molds for machines are cast in dry sand. Rate of casting production varies according to size of castings. Metal charges are composed of pig Fe foundry return and purchased scrap. Castings are heat treated at temperatures from 1500°-1600° F. for 15 to 25 minutes. VSP (3b)

Steel Casting Classifications. DAN M. AVEY. *Foundry,* Vol. 61, Mar. 1933, pages 21, 46, 48-49, 58. Gives definite classifications representing established practice in grouping steel castings according to use and service. They represent the ordinary types of castings made to generally accepted specifications. The tabulated data given were compiled by the *Foundry,* in coöperation with *Daily Metal Trade* and *Steel.* VSP (3b)

Duplexing High Test Gray Iron. W. R. BEAN. *Foundry,* Vol. 61, May 1933, pages 23, 56-57. High test Fe production may be classified into semi-steel produced directly from cupola and air furnace gray Fe produced by direct melting. Duplexing takes advantage of relatively low cost of cupola charge as compared to direct melted air furnace charge, provides maximum flexibility in production of alloy mixtures, permits superheating to temperatures around 2900° F. and may be carried out either on basis of continuous in and out process, the batch process or the semi-continuous process. Desulphurization may be practical in conjunction with duplexing. C reduction in duplexing is effected by control of furnace atmosphere or by addition of borings to bath, depending on amount of reduction desired for castings. Duplexing forehearth may be located adjacent to cupola for direct filling. Cites advantages derived from continuous metal in foundry. VSP (3b)

Small Cupola Handles Rush Jobs. E. S. ENSIGN. *Foundry,* Vol. 61, Aug. 1933, pages 23, 48. Describes the construction and operation of a 12 in. cupola of the Ensign Foundry Co. for melting gray Fe for rush jobs. One man attends to all work of charging and tapping. The shell of the cupola consists of two steel oil drums, one on top of the other held together by four cast Fe angles and bolts. On a 12 in. diameter lining the furnace melts about 1000 lbs. per hr. VSP (3b)

Electric Furnace Cast Iron in the Jobbing Foundry. W. B. CRAWFORD & R. B. CRAWFORD. *Iron Age,* Vol. 131, May 4, 1933, pages 700-702, adv. sec. page 20. Describes the use of the small rocking electric furnace for producing high strength castings made to specifications, with precise control of quality and rapid delivery of castings. Gives results of tests illustrating improvement that the electric furnace makes in quality of cast Fe. Tabulates results. The furnace described was made by the Detroit Electric Furnace Co. and installed at plant of Atlas Foundry Co., Detroit. VSP (3b)

Alloy Electric Steel Castings (A propos des moulages en aciers électriques spéciaux). PAUL MARTHOUREY. *Journal du Four Electrique,* Vol. 42, Dec. 1933, pages 431-433. Marthourey questions the accuracy of figures and facts presented in E. Decherf's paper (Alloy Electric Steel Castings Made at Union Des Acieries de Marcinelle in Belgium, *Journal du Four Electrique,* Vol. 42, Sept. 1933, pages 317-323). JDG (3b)

Notes on Cupola Practice. ROBERT MCMAHON. *Iron & Steel Industry & British Foundryman,* Vol. 6, July 1933, pages 335-338; Aug. 1933, pages 383-384. An account of factors which determine the operation of a cupola. CHL (3b)

Gray Iron Founding. BASIL BARHAM. *Iron & Steel Industry & British Foundryman,* Vol. 6, May 1933, page 267. Electric furnace practice in gray iron foundries is discussed. CHL (3b)

Molding of a Hydraulic Turbine with Its Guide Ring from Old Broken Pieces (Moulage d'une Turbine Hydraulique avec son Distributeur d'apres de vieilles Pieces cassées) M. DEVARD. *Revue de Fonderie Moderne,* Vol. 27, Sept. 10, 1933, pages 250-253. Describes procedure of molding a water wheel of 1200 mm. dia. weighing 1175 kg. and the guide ring of 950 kg. Ha (3b)

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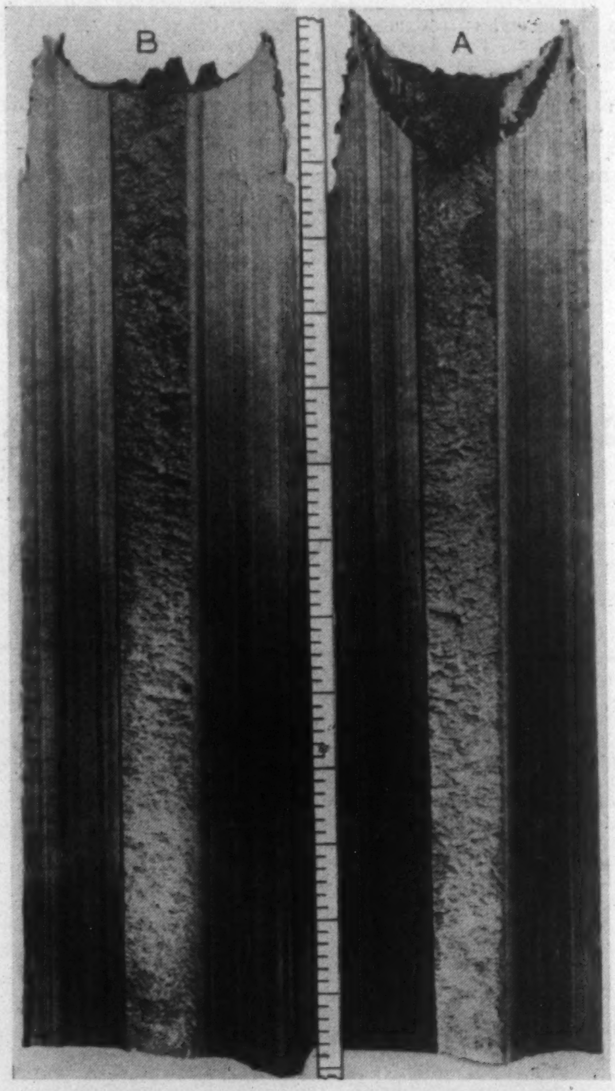

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Melting in the Cupola Furnace (La Fusion au Cubilot) G. Itam. *Revue de la Fonderie Moderne,* Vol. 27, Nov. 10, 1933, pages 291-295. The general principles of melting in a cupola furnace are briefly summarized as follows: continuous melting is possible because the hot gases attack the metal column always at its base so that there is a regular gas flow over the whole section. Drops of melting metal have the melting temperature and are then superheated by the burning gases; superheating is proportional to the thickness of the coke layer above the tuyeres through which the drops run down to the hearth. Walls and hearth are heated at the expense of the ignition coke or of the first molten metal. The tuyeres cool the refractory lining and hinder the descent of slag. Regular descent of the charge is important in order to assure proper cooling of gases and lining at the melting zone. The heating of the metal which takes place at the points of contact with the burning gases is the faster the smaller the pieces are (i.e. the more numerous the points of contact). Increase of wind pressure increases hourly output but also fuel consumption. Clogging of the ignition coke above the tuyeres reduces the passages for the combustion gases and consequently output. Increase of height of the shaft for a given section makes for better economy but increases also danger of sticking of the charge. Thermal efficiency increases with the dimensions of the cupola; for a furnace in good operating condition coke consumption for melting amounts to 8% for a cupola dia. of 900 mm., 9% for 800 mm., 10% for 700 mm., 11% for 600 mm. In the first 4 charges of a furnace the metal is melted partly by combustion of the ignition coke, in all further charges it should be melted entirely by the melting coke. If the temperature can not be maintained it is a sign that there is not enough melting coke to regenerate the ignition coke. The different stages of the melting process and influence of coke, ash content, etc., are discussed. Ha (3b)

The Open-Hearth Steel Melting Department of the English Steel Corporation, Limited. *Engineering,* Vol. 136, Sept. 8, 1933, pages 235-238; *Industrial Chemist,* Vol. 9, Oct. 1933, pages 333-336. Illustrated article describing the layout of each section of the plant. LFM + RAW (3b)

Basic-Bessemer Steelworks. *Foundry Trade Journal,* Vol. 49, Aug. 10, 1933, pages 79-80. A description of a recent installation in Germany, accompanied by 4 illustrations. The location of the plant is not named, but it is said to have been built by Demag (Duisburg). OWE (3b)

Pattern Shop and Foundry Practice. *Machinery,* London, Vol. 42, Sept. 7, 1933, pages 661-666. Discussion of developments at the works of G. & J. Weir, Ltd., Cathcart, Glasgow. The distinction between 3 types of pattern—which are discussed by means of examples—is that of quality, the aim being to produce the patterns quickly and as cheaply as possible consistent with foundry requirements in respect to quantity. Special machines for pattern production are illustrated and discussed. Materials are deposited in bins and those used at the cupola are withdrawn through chutes inside the cupola building. Cupolas are tapped into ladles that are conveyed to and from the foundry on rails running directly beneath the tapping spouts. Cupola charging equipment, sand handling and storage arrangements are discussed. Kzp (3b)

Fifth Report on the Heterogeneity of Steel Ingots. A Joint Committee of the Iron & Steel Institute and the National Federation of Iron & Steel Manufacturers and the Iron & Steel Industrial Research Council. *Iron & Steel Institute,* Special Report No. 4, Sept. 1933, 79 pages. Part I is an introduction. Part II classifies types of ingots with regard to location of porosity and shape of top. These vary from a completely killed ingot through rimming ingots to a "balanced steel" ingot. It is shown that certain classes of ingots can be grouped by segregation and that such a grouping agrees with the one regarding porosity. Part III reviews the methods that have been suggested for the determination of inclusions and O in steel. Part IV, A Further Study of Steel Ingots, describes 3 ingots recently studied. One was a small ingot cast from acid-lined high-frequence furnace steel, another an ingot of acid-Bessemer steel, and a third an ingot of ingot iron. The ingots were sectioned lengthwise, macroetched, sulphur printed, and analyses of drillings from different sections obtained. Inclusion analyses were made at 3 laboratories on portions of the ingot iron. Agreement between the different laboratories was poor. Part V, by C. A. Edwards and H. N. Jones describes small ingots containing different amounts of C and O. O was introduced by adding Fe_2O_3 and controlled by adding different amounts of Al. The mechanism of rimming is discussed. Part VI, by J. H. Andrew and M. Riddihough, gives results of the determination of the Fe_3P-FeS system. Results are in fair agreement with those of Vogel and deVries. A small amount of work indicated that Fe_3P and MnS are insoluble within the limits of practical experimentation. Part VII, by N. M. Lightfoot, is an attempt to estimate mathematically the time taken, after solidification begins, for a steel ingot to separate from its mold. The calculation is quite involved. Estimated times for separation vary from 36 to 2600 sec. for different ingots. JLGp (3b)

Making an Upright Gear Wheel in Two Pieces with Dressed Joint (Fabrication d'une Roue Droite a Alluchons en Deux Pièces a Joints Rabotés) F. Simorre. *Bulletin de l'Association Technique de Fonderie,* Vol. 7, Apr. 1933, pages 136-158. Complete study of the production of a large gear wheel, including (1) allowance for machining, (2) shrinkage, (3) calculation of weight, (4) method of manufacture, (5) pattern making, (6) molding, (7) drying, (8) core making, (9) assembling the mold, (10) pouring, (11) shaking out, (12) cleaning, (13) production time. WHS (3b)

Modern Foundry Developments. W. Scott & S. E. Dawson. *Inspection,* Vol. 4, July 1933, pages 22-31. Paper read at a Meeting of the Institution of Engineering Inspection at Darlington. The complete control of the Fe charged into the cupola has produced material of mechanical strength and improved homogeneity. The variability of cast iron due to composition is dealt with. Sand and molding machines are touched upon. Advantages accruing from rotary furnaces are the high temperatures which can be obtained without any oxidation of the metal, for as soon as it is molten a protective slag layer is formed and metallic losses are reduced to the order of 1%. The rotary movement results in fuel economy and insures an extremely homogeneous metal and it is possible to obtain a metal of the desired composition differing only slightly from the metal charged. A slag comparison table shows the decrease in metal loss in the rotary furnace. The importance of cooling is stressed. The influence of constituents of the Fe on the changes taking place when cast iron cools is discussed. By introducing Ni and Cr an improvement is obtained both as regards resistance to growth and also scaling together with ductility. An austenitic structure with 18% Ni, 6% Si, and 2% Cr, together with low total C proves a good machinable alloy. An austenitic Fe containing 6% Mn and 10% Ni is a non-magnetic cast iron, a harder variety of which can be obtained by replacing some Ni by Cu. The addition of small amounts of Ni and Si to low Si white Fe has been found to produce very dense irons with remarkably high strengths. Kz (3b)

Salt Used to Liquefy Cupola Slag. B. M. Suslov. *Metal Progress,* Vol. 23, May 1933, page 43. The writer describes the results of the use of salt in Russian cupola practice in increasing the fusibility of the slag, and raising the melting efficiency. Corrosion of the lining was decreased. WLC (3b)

Combating Cracking in Slag Ladles (Bekämpfung der Rissbildung bei Schlackenpfannen) A. Wilhelmi. *Stahl und Eisen,* June 22, 1933, pages 641-646. The cracks generally form in the upper part of the slag ladle and are due to the sudden temperature rise during pouring and to growth of the cast-iron. The cracks can be overcome to a large extent by using a finer grained iron, by cooling the ladle with an air blast, and by reinforcing it by bands so as to prevent warpage. SE (3b)

Deoxidation of Steel with Manganese-Silicon-Aluminum Alloys. J. M. Hodge. Master's Thesis, Carnegie Institute of Technology, Pittsburgh, 1932, 19 pages. In collaboration with U. S. Bureau of Mines, Pittsburgh Station. Slags of the $MnO\text{-}SiO_2\text{-}Al_2O_3$ system in the region of the ternary eutectic have melting points from 300°-400° C. lower than those of the Mn silicates. Alloys of Mn, Si, Al made in an induction furnace were used to deoxidize two 250 lb. heats of electric furnace steel. Alloy additions were made to the ladle and 15 lb. ingots were poured. Rapid solidification caused the trapping of inclusions in the ingot. Curves show effect of $\frac{\text{Mn},}{\text{Si} + \text{Al}}\ \frac{\text{Mn},}{\text{Si}}\ \frac{\text{Mn}}{\text{Al}}$ ratios on composition of inclusions. Photo micrographs show size, number, and distribution of inclusions. In order that most of the Al_2O_3 formed may be fluxed by Mn silicates, a Mn-Al ratio of at least 30-1 and a Mn-Si ratio of 5-1 is desirable. Alloys with these ratios give large fusible ternary inclusions. CWS (3b)

Pattern Construction, Pattern and Casting Control (Modellbau, Modellkontrolle, Gusskontrolle) Hugo Hollweg. *Zeitschrift für die gesamte Giessereipraxis,* Vol. 54, Sept. 3, 1933, pages 373-375. Discusses points playing a role in properly making patterns with special reference to machines used. GN (3b)

Melting in the Metal Foundry (Die Schmelzerei in der Metallgiesserei) A. Kretzler. *Die Giesserei,* Vol. 20, May 26, 1933, pages 222-223. The economy of a melting pot depends on its heat conductivity, life and price. Experiments are described made with 2 different kinds of melting pots for melting red brass of 85% Cu, 15% (Sn, Pb, Zn). Ha (3b)

Use of Cement in Molding (Emploi du Ciment dans le Moulage) Lebruly. *Revue de Fonderie Moderne,* Vol. 27, May 10, 1933, pages 135-136. Tests made in France with a mixture of cement to sand in the ratio of 1:6 have given good results, particularly for molding very large pieces. The addition of water must not exceed 0.9 or be less than 0.7 in ratio to cement, as otherwise cohesion and permeability of the mold suffer. The mechanical resistance of such molds is very good. Ha (3b)

Finishing the Heat of Steel. Pt. XIII-XVI. J. H. Hruska. *Blast Furnace & Steel Plant,* Vol. 21, Sept. 1933, pages 478-479; Oct. 1933, pages 532, 540; Nov. 1933, pages 587-588; Dec. 1933, pages 637-639. Deals with difficulties and resultant defects encountered in bottom pouring; base-plates, funnels, and refractories used in bottom pouring; and advantages and disadvantages of bottom pouring. MS (3b)

Processing of Cast Iron Vessel with Attached Flange for Chemical Industry (Die Herstellung eines Gusskessels mit angegossenem Stutzen für die chemische Industrie) A. Freitag. *Zeitschrift für die gesamte Giessereipraxis,* Vol. 54, Oct. 15, 1933, pages 424-425. Vessel, 3850 kg. in weight, 2200 mm. diameter, 1180 mm. high was molded in sand contrary to common practice using loam molding. Molding procedure is outlined in detail. GN (3b)

Electric Steel, Rotary Cast, Bypasses Semifinishing Mills. John D. Knox. *Steel,* Vol. 92, Mar. 13, 1933, pages 11-12, 26, 28. Describes method developed by H. M. Naugle and A. J. Townsend, which will be employed in the new plant of the Rotary Electric Steel Co., Detroit, Mich. Steel is obtained by melting an all-scrap charge in an electric furnace and the melt is poured immediately into the casting machine. This includes a rotary table mounted on a vertical spindle, driven through gears by a motor of small capacity. A circular mold 10 ft. in diameter and designed for 7 x 7-inch blooms is mounted on the table, which is rotated at high speed at the time of casting. The resulting ring is cut into the desired number of sections, which are heated up to rolling temperature in a short continuous furnace. They are rolled into billets on a 3-high breakdown mill and these are converted into cold-finished bars. By this method of casting, the steel is nondendritic and the yield of sound steel obtained is about 98%. MS (3b)

Viscosity of Molten Slag From Acid and Basic Open Hearth Furnace. T. Matsukawa. *Suiyokwai-shi,* Vol. 8, June 1933, pages 245-256. Viscosity of molten slag has been measured by a rotating cylinder method. The addition of fluor spar to basic open hearth furnace slag makes it more fluid and lowers the m.p. about 100° C. by 1% of fluorine. The viscosity of the slag in which the sum of CaO, MgO and MnO is about 60%, and MnO varies from 0.32-13.64%, is decreased with the rise of MnO-content, and its m.p. is lowered. However, the increase of MgO raises the m.p. markedly in the slag containing about 36% of CaO-MgO. HNp (3b)

Centrifugally Cast Guns (Geschleuderte Geschützrohre) Peter Jens. *Technische Blätter der deutschen Bergwerkszeitung,* Vol. 23, Oct. 15, 1933, page 585. Briefly discusses American experiences in centrifugally casting guns. GN (3b)

Blow-holes in Steel Castings (La Fonderie d'Acier-Les Soufflures) M. Guédras. *Revue de Fonderie Moderne,* Vol. 27, Mar. 25, 1933, pages 92-94. The differences between blow-holes and pipes are explained; the former are mostly due to gases emanating from molten steel and consist mainly of CO from the reactions of C with FeO and MnO. Rusty ingot molds, humidity in sand molds, too low temperature are discussed as causes for holes. Several examples are analyzed showing the reasons in every case. Ha (3b)

Basic Bessemer Steel. T. H. Burnham. *Iron & Steel Industry & British Foundryman,* Vol. 6, Aug. 1933, pages 369-370. Discussion of possibilities for basic Bessemer steel manufacture in England. CHL (3b)

Dephosphorization and Desulphurization in the Coreless Induction Furnace (Die Entphosphorung und Entschwefelung im kernlosen Induktionsofen) P. Bardenheuer & W. Bottenberg. *Archiv für das Eisenhüttenwesen,* Vol. 7, Oct. 1933, pages 229-232. See "High Frequency Induction Furnace. VII. Dephosphorization and Desulphurization in the Coreless Induction Furnace," *Metals & Alloys,* Vol. 4, Dec. 1933, page MA 392. SE (3b)

Inverted Ingot Segregation (Beitrag zur Kenntnis der umgekehrten Blockseigerung) F. Hoehne. *Die Giesserei,* Vol. 20, Nov. 24, 1933, pages 523-525. Trial melts of Cu-Sn bronzes revealed the fact that melting in a reducing atmosphere produces extensively inverted segregation while it is very much limited in an oxidizing atmosphere. The phenomenon is caused mainly by disengagement of H during solidification. High water vapor content in the melting atmosphere also favors inverted segregation. In order to minimize the latter melting should be done in such way that an atmosphere poor in H, hydro-carbons and water vapor is present over the metal bath. This can be easily obtained by use of water-poor fuels and a slightly oxidizing melting process. 11 references. Ha (3b)

Cast Iron and Its Production. M. V. Healey. *Electrical Engineering,* Vol. 53, Jan. 1934, pages 120-123. A brief description of cast iron and a comparison of the cupola and the electric furnace processes. In the latter, the production of iron of any composition with accurate control is possible, while the cupola produces only a high carbon iron (3% or more C). Cupola cast iron is coarse-grained and non-uniform, while the superheating in the electric furnace dissolves this suspension and permits the production of a fine grained uniform material. Electric furnace control is positive, yet flexible in operation. WHB (3b)

Duplex Process : Converter-Electric Furnace (Marche duplex convertisseur-four électrique). Albert Kayl. *Journal du Four Electrique,* Vol. 42, Oct. 1933, pages 359-362. A very detailed description of basic converter-electric furnace process for making steel castings. A 1500 kg. converter and a 3 ton electric furnace are used. 5 heats in 9 hours can be made with a considerable saving in cost. JDG (3b)

Melting of Low Carbon Cast Iron in the Cupola (La Fusion au Cubilot de Fontes a Bas Carbone) R. Lemoine. *Bulletin de l'Association Technique de Fonderie,* Vol. 7, Oct. 1933, pages 380-383. Cast iron having as low as 1.50% C may be obtained from the cupola. Cast iron containing 2.60% C, with high Si and low P content, may be cast in sections of 0.2 inches and over. A low carbon pig iron is produced in the cupola and remelted with additional steel. WHS (3b)

Trends in the Construction of American Open-Hearth Plants (Entwicklungslinien im Bau amerikanischer Siemens-Martin-Werke) H. BLEIBTREU. *Stahl und Eisen,* Vol. 53, Feb. 2, 1933, pages 113-121. The development in layout and constructive details of American steel plants is described. Simplicity, cheapness and reliability are stressed. Operating details and distribution of costs to material and labor are discussed. Ha (3b)

Present State of Methods for Determination of Oxygen and Oxides in Iron and Steel (Etat actuel des méthodes de dosage de l'oxygène et des oxides dans le fer et l'acier) R. CASTRO & A. PORTEVIN. *Revue Universelle des Mines,* series 8, Vol. 9, Mar. 15, 1933, pages 162-164. See *Metals & Alloys,* Vol. 4, July 1933, page MA 225. Ha (3b)

Construction and Operation of New Basic Bessemer Plant (Bau und Betrieb des neuen Thomasstahlwerk von Hoesch-Köln Neuessen A-G. in Dortmund.) W. BROEL & A. DITTMAR. *Stahl und Eisen,* Vol. 53, July 20, 1933, pages 749-757. A description of the construction and layout of the two 45-ton converters is given as well as a summary of operating details. SE (3b)

Handling and Conditioning of Sand in a Small Gray Iron Foundry. MAX A. AMOS & ROBERT W. GRACE. *Transactions American Foundrymen's Association,* Vol. 41, 1933, pages 144-157. Mechanical handling and conditioning of sand reduced the cost of sand to molder about 12 cents/ton while reducing greatly the scrap loss in the foundry. CHL (3b)

Casting of Wrought Iron Spokes in Cast Iron Hubs (Das Eingiessen schmiedeeiserner Speichen in gusseiserne Naben) GUSTAV KREBS. *Zeitschrift für die gesamte Giessereipraxis,* Vol. 54, Oct. 15, 1933, pages 422-424. Discusses in detail molding of wheels of agricultural and similar machinery. Best method for obtaining accurate hubs with well centered spokes is to use cast Fe patterns. GN (3b)

A Method for the Electrolytic Extraction of Slag from Iron and Carbon Steel. R. TREJE & C. BENEDICKS. *Iron & Steel Institute,* Advance Copy No. 16, Sept. 1932, 26 pages. A translation of a Swedish article together with some new data. See *Metals & Alloys,* Vol. 4, May 1933, page MA 153. JLG (3b)

Patterns and Patternmaking. E. LONGDEN. *Iron & Steel Industry & British Foundryman,* Vol. 6, Apr. 1933, pages 311-314. See *Metals & Alloys,* Vol. 4, Oct. 1933, page MA 329. CHL (3b)

Molding of Cast Iron Bath Tubs from a Sheet Pattern (Das Formen gusseiserner Badewannen nach einen Blechmodell) K. W. SCHMIDT. *Die Giesserei,* Vol. 20, Apr. 14, 1933, pages 156-157. Describes molding practice and arrangement of gates and risers. Ha (3b)

Castability and Viscosity. Supplementary Notes on the Study of Iron-Carbon System (Coulabilité et Viscosité. Notes Complémentaires à l'Etude du Système fer-carbone) R. BERGER. *La Fonderie Belge,* Vol. 2, Dec. 1932, pages 242-243. See "Running Quality of Molten Metals," *Metals & Alloys,* Vol. 4, Nov. 1933, page 176. FR (3b)

Development of Inclusions During Manufacturing of Steel (L'Evolution des Inclusions dans l'Elaboration des Aciers) R. PERRIN & A. PORTEVIN. *La Technique Moderne,* Vol. 25, July 1933, pages 502-503. See *Metals & Alloys,* Vol. 4, Dec. 1933, page MA 392. FR (3b)

Savings in Processing Rope Drums (Ersparnisse bei der Anfertigung von Seilscheiben) *Zeitschrift für die gesamte Giessereipraxis,* Vol 54, Nov. 12, 1933, page 469. Comments on former paper on the subject in *Zeitschrift für die gesamte Giessereipraxis,* Vol. 53, Dec. 11, 1932, pages 489-490. See *Metals & Alloys,* Vol. 4, Oct. 1933, page MA 330. GN (3b)

Production of Sweeps and Mold of a Two-Part Turbine Bearing (Herstellung der Schablonen und der Form zu einem zweiteiligen Turbinen- Lagerkörper) *Zeitschrift für die gesamte Giessereipraxis,* Vol. 54, Nov. 12, 1933, pages 475-478. Detailed discussion of the molding procedure. GN (3b)

Molding of an Evaporator Cap (Wie soll die Verdampferhaube geformt werden?) *Zeitschrift für die gesamte Giessereipraxis,* Vol. 54, Nov. 26, 1933, pages 497-499. Paper discusses 3 various methods of sweep molding the shell of a mixing vessel. GN (3b)

Processing of a Condenser Casing (Die Herstellung eines Kondensatormantels) *Zeitschrift für die gesamte Giessereipraxis,* Vol. 54, Oct. 1, 1933, pages 413-414. Piece was sweep molded on loam. Procedure of molding is outlined in detail. GN (3b)

Desulphurization of Gray Cast Iron (Das Entschwefeln von Grauguss) *Zeitschrift für die gesamte Giessereipraxis,* Vol. 54, Nov. 26, 1933, page 490; Dec. 10, 1933, page 510. In the first paper investigations by Colbeck & Evans (*Foundry Trade Journal,* 1931, pages 35-307) on desulphurization of gray cast Fe with soda are reviewed. In the second paper disadvantages of Colbeck & Evans method are pointed out. It is stressed that other and better means, as the material "Bruinella," for instance, are available on the German market. GN (3b)

Large or Small Tuyeres in Cupolas? (Grosse oder kleine Düsen am Kupolofen?) *Zeitschrift für die gesamte Giessereipraxis,* Vol. 54, Dec. 24, 1933, pages 529-530. Small tuyeres offer the following advantages over large ones: Lining near nozzles is not so heavily attacked, fluctuations of blast volume and pressure are smaller, melting is more uniform, oxidation in front of tuyeres is but slight. GN (3b)

New Ingot-Strippers (Neuere Blockabstreifvorrichtungen) *Stahl und Eisen,* Vol. 53, June 15, 1933, pages 628-631. Contains illustrations and drawings of various new ingot-strippers. SE (3b)

Development in Materials for Water Mains. *South African Electrical Review & Engineer,* Vol. 24, Oct. 1933, pages 19 and 21. Compares ordinary cast iron pipe with centrifugally cast pipe, and discusses the value of spun concrete and bitumen linings in steel pipe. The growing use of copper piping for services is due to the fact that it is virtually permanent. RRS (3b)

Molding of Bathtubs from Sheet Patterns (Le Moulage des Baignoires sur Modèle en Tole) *Revue de Fonderie Moderne,* Vol. 27, Aug. 25, 1933, pages 234-235. A brief review and description of modern simplified methods of molding bathtubs by patterns made of sheet steel. Ha (3b)

High-Strength Cast Iron Demonstrates an Unusual Degree of Toughness. *Steel,* Vol. 92, Feb. 27, 1933, page 23. Foundry specializing in wheels for safes and other small parts in which great toughness is required produces cast-iron from a charge consisting of 50% steel scrap and the balance pig-iron and cast scrap. Content of Si is brought up to 2.5% by cupola additions of Si in briquet form. MS (3b)

Cost of Steel Cut by Furnace Control and Insulation. *Steel,* Vol. 92, Jan. 2, 1933, pages 87, 89. Reviews progress made in 1932 in open-hearth practice. MS (3b)

Produce Better Castings at Greatly Reduced Costs. *Steel,* Vol. 92, Jan. 2, 1933, pages 96-97, 100. Review of developments in foundry practice made during 1932. MS (3b)

Shrinkage of Pulleys (Retrait des Poulies) Technical Committee of Belgian Foundry Association. *La Fonderie Belge,* Vol. 2, Nov. 1932, pages 223-224. Continuation of report on recent investigations. Results obtained are in accordance with those previously reported and confirm theory advanced. Those results show that other things being equal tension strain in arms of pulley increases with increasing diameter of hubs; even when thickness of hub is kept constant by using internal core. FR (3b)

Works of the North British Steel Foundry, Limited. *Foundry Trade Journal,* Vol. 49, July 27, 1933, pages 45-46. A description of the works of the North British Steel Foundry, Limited, Bathgate, Scotland, accompanied by 5 illustrations. OWE (3b)

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Special Processes for Making Cast Iron of High Mechanical Qualities (Les Procédés spéciaux de Fabrication de Fontes à Characteristiques Méchaniques élévées) Le Bruly. *Revue de Fonderie Moderne,* Vol. 27, Dec. 25, 1933, pages 337-338. Some modern processes of producing a high-quality cast iron by retarding and diminishing graphitic separation during and immediately after solidification (i.e. in a state of still sufficient plasticity for formation of coarse graphite crystals) are briefly described. They are: 1. The pearlitic process of Lanz in which the metal is cooled very slowly by as small a temperature difference between metal and mold as practically possible; C + Si vary from 4.60 to 3.50%, molds are heated to about 500° C. Tensile strength about 26-30 kg./mm.^{2}. 2. Process Emmel which is based on low C content of the charge, small percentage of coke for fusion and consequently rapid melting with strong blast; C + Si about 5%, tensile strength about 30-40 kg./mm.^{2}. 3. Process Krupp, which is essentially the same as 2. 4. Process Corsalli, which retards and limits recarburation of the metal in the cupola by reducing the reaction of the coke by immersing the latter in milk of lime. C content 2.6-3.0%, tensile strength 34-40 kg./mm.^{2}. 5. Some other processes are briefly mentioned based on quality of pig iron rather than on composition of charge. Hap (3b)

Six Competitive Types of Castings. D. Basch. *Product Engineering,* Vol. 4, Aug. 1933, pages 282-284. A method of procedure is explained by which the most economical type of casting for a given part may be determined. A table showing relative characteristics of different casting methods and the materials suitable for them is added. Hap (3b)

Graphic Solution of Melting Charge Calculations (Graphische Lösung schmelztechnischer Berechnungen) Alfred Köster. *Metall und Erz,* Vol. 30, Oct. 1933, pages 406-407. Instructions are given for the preparation and use of nomographs for calculating the proportions of a melting charge to make an alloy of specified composition, containing 2 or 3 elements, when alloys containing the same elements, but in different proportions, are to be used. Several examples are worked out. CEMp (3b)

Figuring Melting Cost of Iron. J. J. Rowbottom. *Foundry,* Vol. 61, Mar. 1933, page 36. Method of treating cost of Fe as a separate component when figuring castings costs, a thorough knowledge of that cost becomes necessary. Error in factor generally means the difference between profit and loss. Following items make the cost: (1) Raw materials, plus freight. (2) Raw materials, unloading. (3) Labor transferring to charging floor, make up charges, placement in cupola. (4) Labor, preparation of cupola, tapping out, and conveyance of Fe to molder floor. (5) Cupola supplies. (6) Power. (7) Share of general overhead. (8) Losses in melting and handling. VSP (3b)

Graphitization in Cast Iron (Ueber die Graphitbildung im Gusseisen) W. W. O. Ruff. Doctor's Dissertation, Technische Hochschule Carolo-Wilhelmina, Braunschweig, published by Stahldruck Dortmund, July 19, 1932, 16 pages. Using Scheil's method (see article by H. A. Schwartz, *Metals & Alloys,* Vol. 2, Sept. 1931, page 143) data were obtained on the number and size distribution of the graphite flakes of various sized specimens of chilled and sand-cast cast iron. The average size of the graphite flakes along the cross-section, from surface to center, of the different specimens are shown in tables and curves, as well as the number of each size/mm.^{3}. The numerical data obtained agree, of course, with qualitative estimates one might make from ordinary microscopic observations, e.g., the flakes were larger in the larger specimens—in sand cast than in chilled specimens—and at the center than at the surface. In support of the theory of graphitization directly from the melt, the rather doubtful argument is submitted that in cast iron alloyed with Co and Ni, in which the carbides should be even less stable than pure Fe_3C, the "iron-graphite eutectic" has the same appearance as in ordinary cast iron. The number of graphite nuclei were observed to greatly influence undercooling and vice versa; it is indicated that O_2 in the melt tends to increase the number of graphite nuclei. SE (3b)

Inclusions in Acid Electric Steel. Henry D. Phillips. *Foundry,* Vol. 61, May 1933, pages 21-22, 48, 50. Three major classes of inclusion found in steel are: (1) Oxides (including silicates, aluminates, etc.); (2) Sulphides; and (3) Oxide-sulphides. Other sources of inclusions may come from slag in contact with metal, refractories or mold. Factors other than visible inclusions have an important influence on properties of steel. Two methods of deoxidation available. One takes advantage of equilibrium existing between deoxidizing metals and FeO in a homogeneous Fe solution, by addition of excess of alloy direct to metal to react with dissolved FeO, and results in precipitation of insoluble inclusions with resultant troubles attending their elimination, segregation, etc. The other method takes advantage of equilibrium existing between metal and slag, by placing over metal a slag free from oxides. Al is added to steel for castings primarily because of its speed of reaction with O in immigrant mold gases. Mn promotes soundness of steel castings through its deoxidizing action. Type of inclusion formed and chances of elimination are influenced greatly by manner and form in which Si and Mn are added. VSP (3b)

Oxygen in Acid Electric Steel. Henry D. Phillips. *Foundry,* Vol. 61, Mar. 1933, pages 13-14, 50, 52. The quality of the steel depends on the extent of Fe oxide elimination. If not enough is removed "wild" steel results and if too much, other undesirable results may be evident. Fluidity in steel is related to the presence of dissolved oxide or suboxide of Fe. Control of dissolved Fe oxide in steel for castings results in increased productivity from metal in ladle due to almost entire absence of metal freezing in nozzle, or in hand-shanks, and reduced size of risers used. Describes the melter's count test for measuring the fluidity of the steel and gives an example of an over-reduced condition in acid electric steel. It seems advisable to so produce the steel that Si is not reduced from the slag to enter the metal and to so control the composition of molding sand that the minimum addition of Al is required to produce castings unafflicted with pin hole defects. VSP (3b)

Mass Production Methods for Malleable Castings. Herbert R. Simonds. *Iron Age,* Vol. 131, Mar. 23, 1933, pages 466-467, adv. sec. page 10. Changes in railroad rolling stock during recent years, caused corresponding changes in foundry industry. Railroad castings are now made of alloy steels and malleable Fe. The large demands made it possible to put operations on an efficient quantity production basis. Some of the features of a large malleable foundry are described. VSP (3b)

Use of Titanium in Steelmaking. George F. Comstock. *Blast Furnace & Steel Plant,* Vol. 21, Aug. 1933, pages 412-414; Sept. 1933, pages 474-475. Discusses use of Ti as a deoxidizer and an alloying element. It is exceeded only by V and Al in deoxidizing power. TiO_2 is more easily eliminated from the melt than the oxides of other elements used as deoxidizers. Largest use of Ti involves the alloy known as ferro-carbon-titanium, which is claimed to be the best deoxidizer for effervescing steels, and is very generally so used, since it does not leave any residue in the finished metal. Amount of ferro-carbon-titanium needed is generally between 1 and 3½ lb. per ton of steel in the ladle, for effervescing steel. In large heats the ladle is generally held about 10 min. from the time of the Ti addition before pouring the first ingot. Better yields of sheets and plates are obtained from Ti-treated steel. In killed steel, Si is always used with the Ti alloy. The steel is first deoxidized with about 3-5 lb. of 50% ferrosilicon per ton in the ladle and then from ½-2 times as much ferro-carbon-titanium is added. Use of Al with the Ti alloy does not give as clean steel as the Si-Ti combination. In steel for castings, 4-8 lbs. of ferro-carbon-titanium per ton is general practice. In plain C or alloy forging steels, as much as 10 lb. may be added, and in rail steels, 8-13 lb. per ton. Ti is used as an alloy in steel to produce either an age hardening effect or to control carbide precipitation, particularly in low-C austenitic steels. A Ti alloy with low C must be used. MS (3b)

Quantity of Air, Coke Charged, and Output in the Cupola (Windmenge, Kokssatz und Schmeltzleistung bei Kupolöfen) H. Jungbluth & A. Heller. *Archiv für das Eisenhüttenwesen,* Vol. 7, Sept. 1933, pages 153-155. For equal amounts of coke charged, the output of a cupola varies with the air input and the consequent proportion of CO_2 and CO in the furnace gases. With equal air input increasing coke charged results in more CO and less CO_2. As a first approximation the output of a cupola is inversely proportional to the amount of coke burned by the air to CO_2. SEp (3b)

Contribution to the Knowledge of Operation of Cupola Furnaces in Melting of High Quality Gray Cast Iron (Beitrag zur Kenntnis des Kupolofen betriebes beim Erschmelzen von hochwertigem grauen Gusseisen) K. Neustaetter. *Mitteilungen aus den Forschungsanstalten des GHH-Konzerns,* Vol. 2, Mar. 1933, pages 112-134. The quality of a cast Fe produced in the daily routine in a cupola furnace of the Maschinenfabrik Esslingen was investigated and evaluated by quantum statistical methods from which the following conclusions can be drawn; The melting capacity increases with increase of the amount of air and simultaneous decrease of the tapping temperature. With increasing amount of air the C content increases at first but decreases for very high air quantities. With increasing tapping temperature the Si content of the melted Fe decreases, but Mn, P and S content are not influenced by the amount of air. FeO content of the slag is at first reduced by increasing air, but the MnO content of the slag is not influenced. The maximum kg. of molten metal/kg. air is obtained for low air quantities. Increased air pressure increases melting capacity and reduces tapping temperature; the same holds good for high barometric pressures, while high absolute humidity of the air has the opposite effect and reduces the C content of Fe and apparently also S. Increased air humidity increases the hardness of the Fe without influencing tensile and bending strength. Fe of the same burden is always harder in summer than in winter. The melting output and tapping temperature are greater the larger the coke pieces. Rust in the scrap reduces tensile and bending strength and increases hardness somewhat but reduces the C content and increases FeO content of the slag. Varying sizes of scrap pieces do not influence the melt if the percentage of scrap is not too high. If part of the scrap in the burden is replaced by gates from castings tensile and bending strength and hardness can be increased and S content reduced. Separation of graphite is reduced by high temperature and low melting output as also by low air quantities, and by much rust on pig iron and scrap. 46 references. Hap (3b)

Electric Foundry Practice (Aus der Praxis der Elektrogiesserei) Rud. Genwo. *Die Giesserei,* Vol. 20, Apr. 14, 1933, pages 151-155. Practical experiences in the operation of electric furnaces for iron, steel and malleable castings are discussed. Electrodes and door of the furnace must be as airtight as possible to prevent too much air circulation; this contributes to the production of a non-porous steel casting and reduces the quantity of additions of ferro-silicon, ferro-manganese, etc. in the production of alloyed steels. Acid electric steel is (in Germany) not made to a great extent as it is inferior to basic steel with regard to mechanical properties. The acid furnace is most suitable for steel castings of 0.2 to 0.75% C with P below 0.06 and S below 0.07%; very dense castings are produced, the steel is very liquid and fills easily very thin wall thicknesses. The energy consumption of 2 Heroult furnaces is given in the following table:

	4-5 ton furnace	2-2½ ton furnace
basic	800-900 kw.hr./ton	850-1000 kw.hr./ton
acid	650-775 kw.hr./ton	700-850 kw.hr./ton

The lower consumption in the acid furnace is due to the radiation losses being smaller as the slag has a lower thermal conductivity than in the basic furnace. The electric furnace is particularly suitable for material of hard-cast rolls with high C and 0.4-0.6 Mn. The castings are much more uniform than can be produced in the cupola furnace. Several tables give results of tests of electric iron and steel. Hap (3b)

Sand Control in the Steel Foundry. A. V. Leun. *Iron & Steel Industry & British Foundryman,* Vol. 6, Apr. 1933, pages 243-247. Paper presented at the American Foundrymen's Association, 1932. See *Metals & Alloys,* Vol. 4, Oct. 1933, page MA 330. CHL (3b)

Thermal Study of Lime—Silica—Phosphate System. (Beitrag zur thermischen Untersuchung der Kalk—Kieselsäure—Phosphat) G. Behrendt & H. Wentrup. *Archiv für das Eisenhüttenwesen,* Vol. 7, Aug. 1933, pages 95-102. Synthetic melts, particularly in the composition region of basic Bessemer slags were melted in an induction furnace in a rhodium crucible and thermal-analyses made by means of a radiation pyrometer. SE (3b)

Formation of Phosphate Slags and their Significance in the Production of Basic-Bessemer Slag Fertilizer (Forschungen über den Aufbau der Phosphatschlacken und ihre Bedeutung für die Thomasmehlerzeugung) F. Körber & G. Trömel. *Archiv für das Eisenhüttenwesen,* Vol. 7, July 1933, pages 7-20. Contains a summary of previous studies, with a review of the determinations of the $CaO\text{-}P_2O_5$ and $CaO\text{-}P_2O_5\text{-}SiO_2$ equilibrium diagrams. The relative solubilities of various calcium phosphates in citric acid and ammonium citrate is given and discussed. After trials in the laboratory with the addition of crude phosphates to basic phosphate slag, similar experiments in basic Bessemer and open-hearth furnaces were made. The technical possibility was demonstrated of adding crude phosphates to the molten slags with accompanying additions of alkalies and sand, to produce a basic slag fertilizer rich in phosphates. At present fertilizer prices it is questionable, however, whether the process is economical. 30 references. SE (3b)

Making Quality Steels. Emil Gathmann. *Blast Furnace & Steel Plant,* Vol. 21, Sept. 1933, page 484; Oct. 1933, page 534; Nov. 1933, pages 590-591; Dec. 1933, page 642. Term "quality" refers to the degree of excellence or reliability of steels of similar chemical analyses. Two most important factors in the making of high grade steels are the finishing of the heat and the method of solidification of the ingot. Types of "quality" steels are the killed and the rimming steels. Control of the volumetric shrinkage of the steel in the mold is of utmost importance. In making quality rimming steel, it is important that a relatively thick skin of physically sound steel forms before blow-holes form, and that no well-defined pipe forms in the upper portion of the ingot. In high quality rimming steels, content of C may be 0.04-0.12%, Mn 0.20-0.45%, S under 0.05%, P under 0.01%, and Si, residual. In average size rolling-mill ingot, the height should not exceed 3 times the diameter of the ingot. Temperature of the molds should be uniform, preferably 200°-300° F. Success of a rimming heat depends on the judgment of the steel maker and the addition of Al. In making fully killed steel, most of the deoxidizing should be carried out in the furnace. Al is added to the metal in the ladle to complete deoxidation. It is better to use more rather than less Al. Under no circumstances should a deoxidizer be added to the metal in the mold. Use of a well-designed big-end-up mold fitted with a hot-top will result in at least 87% of a fully killed ingot being without internal flaws of any kind. MS (3b)

Making Steel of a Uniform Quality. Lewis B. Lindemuth. *Iron Age,* Vol. 131, April 6, 1933, pages 540-541; **Deoxidation in the Steel Making Process.** April 13, 1933, pages 582-583. Outlines a method of preventing the uncontrollable factors from adversely affecting an already attained quality. Relationship between pipe and blow-holes is approximately definite for all grades of steel except rimmed steel. Whether top surface of ingot is concave, flat, convex or boiled up, is an accurate indicator of internal structure of ingot with regard to pipe and blow-holes, provided top surface has not been retarded in freezing over. To produce uniform type of ingot under variable conditions of oxidation it is necessary to complete the deoxidation with a deoxidizer, such as Al, added in mold while pouring. Quality is best obtained by reducing to a minimum the necessity for deoxidation. In basic process Mn is the only economically available element for accomplishing this. Discusses deoxidation. VSP (3b)

WORKING (4)

Methods of Working and Fabricating Magnesium Alloys. *Machinery,* New York, Vol. 39, July 1933, pages 721-723. Review of German practice in casting, forging, pressing, rolling, drawing, and welding light weight Mg alloys. RHP (4)

Rolling (4a)

RICHARD RIMBACH, SECTION EDITOR

Rolling Merchant Bars. W. Trinks. *Blast Furnace & Steel Plant,* Vol. 21, Sept. 1933, page 485; Oct. 1933, page 535. Discusses rolling of high-grade bars on the straight continuous and the cross-country types of mill. Opinions that bars rolled on a cross-country mill have superior physical properties (because of rolling to and fro) and easily removable scale are held to be untenable. Another claim is made that this type of mill produces better results because of the low finishing temperature of the bars. If the finishing temperature is low, a thin coating of scale is formed, the bar keeps its shape better, and the cross-section is more uniform. It is often stated that high grade bars must not be twisted during rolling, as the steel is injured thereby. There is no logical reason for this. The desire to avoid scratches caused by twisting guides is probably the true reason for the specification. Twisting can be prevented by the use of horizontal and vertical rolls and by edging the bar in the cross-country part of the mill. MS (4a)

Blooming Mills. W. Trinks. *Blast Furnace & Steel Plant,* Vol. 21, Oct. 1933, page 535; Nov. 1933, page 591. Modern blooming-mills furnish more and better steel than those of 30 years ago. To produce good steel requires very slow speed and small reductions in first 2-4 passes. Steel cannot be injured by high speed and heavy drafts in subsequent passes. Electric motor meets requirement for very slow, steady speed in first passes more easily than the steam-engine, but in the later passes requiring enormous acceleration and retardation, latter is preferable. The speed of the screw-down and especially of the manipulator are more important than the speed of the mill proper in determining the capacity of a mill. Electricity being so much more convenient than hydraulic power, screw-downs are operated almost entirely by electric power. Hydraulic power seems to be favored in the case of the manipulator, because of the great accelerating and decelerating power of high-pressure H_2O. Use of pressure oil has advantages. MS (4a)

Using Forged Plate Housings on 84-Inch Cold Mill. H. G. Marsh. *Steel,* Vol. 92, Mar. 13, 1933, pages 23-25. Abstract of paper read before a joint meeting of the New York Section, American Welding Society and the American Society of Mechanical Engineers. Roll housings for the 4-high mill being installed at the Gary, Ind., plant of the American Sheet and Tin Plate Co. are being made of 4 forged steel plates, flame cut to shape, and electrically welded together. Housing is essentially a large link of steel keyed and bolted in a cast-steel base. A self-contained screw-down mechanism sets inside the link and exerts pressure between the rolls and the inside of the top of the link. MS (4a)

New Tolerances for Roll Steels. B. I. Panchenko. *Domez,* No. 8, 1933, pages 32-36. In Russian. Steel famine created by severe underproduction might be relieved somewhat by using closer rolling tolerances. A new set of them superseding the former specifications is given. (4a)

Tubing Made with a Thin Outer Layer of Stainless Steel. *Machinery,* New York, Vol. 39, June 1933, pages 638-639. Describes a method of rolling a covering strip of stainless steel only 0.015″ thick over an ordinary steel tubing having a wall ⅛″ thick. The rolling is so well done that the 2 metals practically become one. Shows machinery used for this operation. RHP (4a)

A New Process for Rolling Large Seamless Tubes (Ein Sonderverfahren zum Auswalzen grosser nahtloser Rohre) M. Roeckner. *Stahl und Eisen,* Vol. 53, Oct. 26, 1933, pages 1101-1105. A new process of rolling large seamless steel tubes 500 mm. and over in diameter, with relatively thin walls is illustrated. Hollow ingots with the inner and outer skin machined off are first reduced in wall thickness over a mandrel and then rolled to the desired size through sets of interior and exterior rolls. SE (4a)

Durability of Rolls for Hot-Rolling Sheets (Zur Frage der Haltbarkeit der Blechwarmwalzen) W. Gernhard. *Die Giesserei,* Vol. 20, Sept. 8, 1933, pages 406-408. The durability of a roll depends rather upon the plastic deformability of the core of the roll, not so much upon the strength of the quenched casing. It is considered natural that the life of a roll will always only be limited on account of the extremely high stresses to which these rolls are subject. Ha (4a)

Trend of Rolling Mill Design. E. L. Williams. *Blast Furnace & Steel Plant,* Vol. 21, Mar. 1933, pages 154-156. **Cluster Mills, Four-High Mills and the Trend of Rolling Mill Design.** *Metal Industry,* London, Vol. 41, Nov. 18, 1932, pages 489-490. See *Metals & Alloys,* Vol. 4, Nov. 1933, page MA 359. MS + Ha (4a)

Lubricating a 48-in., 3-high, Universal Mill. Louis H. Hein. *Blast Furnace & Steel Plant,* Vol. 21, Feb. 1933, pages 99-102. Describes centralized system which has been in operation for almost a year. MS (4a)

Rolling, Shaping, Forming of Nickel Chromium Austenitic Stainless Steels (Laminage, chaudronnage et moulage des aciers inoxydables austenitiques au nickel chrome) Gendreau. *Revue du Nickel,* Vol. 3, July 1932, pages 106-112. Description of methods for forming austenitic stainless steels. AH (4a)

Modern Lubrication on Hot Mills. Robert M. Gordon. *Blast Furnace & Steel Plant,* Vol. 21, May 1933, pages 251-254. Describes method of lubricating sheet mills consisting of an improved type of lubricant and an automatically controlled centralized system of lubrication. Grease is soft and pliable at ordinary temperatures, yet, has remarkable body at operating temperature of the necks. It has a very low percentage of ash. System is of the single-line type. Pumping unit takes grease directly from original container, which is placed in a box or tank, kept warm by a steam-coil and forces it through the main grease line. Control unit automatically trips valves at specific, regulated time intervals, to distribute the grease to the various necks. Discusses advantages of good lubrication. MS (4a)

Design of Skewed Rolls for Seamless Tubes (Die Kalibrierung der Schrägwalzen für nahtlose Rohre) P. Gorol. *Stahl und Eisen,* Vol. 53, Apr. 27, 1933, pages 422-425. The rolls were designed by determining to what extent the rolled work did not fill out or otherwise conform to the desired shape. The necessity of a sufficiently wide pressure-surface was emphasized. SE (4a)

Design of Rolls for I and Channel Beams (Einiges über die Kalibrierung der I und ⊔ Eisen) W. Gernhard. *Die Metallbörse,* Vol. 22, Aug. 27, 1932, pages 1101-1102; Sept. 3, 1932, pages 1133-1134. Tabulates data and illustrates shape of passes for roll design of a reversing two high rolling mill comprising rolls of 850 mm. diameter and 2200 mm. length when using a bloom of 240 × 220 mm. finished in 9 passes. The economy of using a closed pass in which the channel beam flanges are upset is critically discussed with reference to I iron NP 15 and 16 rolled in a 3 high mill (670 mm. diameter and 1800 mm. roll length) from a 150 × 165 mm. bloom in 13 passes. The loss of time and the increased rolling work is stressed. Instead of an up-set pass the use of a second bloom pass is suggested. EF (4a)

Rolling of I Section (Die Herstellung von I-Eisen Normalprofil 20 auf einer mittleren Walzenstrasse) W. Gernhard. *Die Metallbörse,* Vol. 23, Dec. 10, 1932, pages 1581-1582. Advantageous use of a medium sized 3-high rolling mill comprising rolls of 550 mm. diameter and 1500 mm. length for rolling the German standard profiles 18-22 is discussed and the dimensions of the 11 pages given in drawings. The initial bloom is 155 × 180 mm. EF (4a)

Roll Design for The Second Train of Continuous Billet Mill. A. Vinogradov. *Domez,* 1933, No. 7, pages 1-3 (In Russian). Theory of roll design offered before (*Domez,* 1933, No. 2, pages 1-10) was applied to the design of the second stand of Indiana Steel Company plant at Gary, Ind. The calculated passes checked well with those used in practice. (4a)

Cold Rolling of Sheets and of Tinplate. W. Trinks. *Blast Furnace & Steel Plant,* Vol. 21, June 1933, pages 315-320. Presents the theory advanced by Siebel in "Die Formgebung im bildsamen Zustande," with additions by the author, and some of the experimental results reported by Siebel and Lueg in *Mitteilungen aus dem Kaiser-Wilhelm-Institut für Eisenforschung zu Düsseldorf,* Vol. 15, 1933, pages 1-14. Latter are in close agreement with deductions from the theory. Points out importance of skin friction for thin sheets. It is reduced by small working rolls, optimum lubrication between strip and rolls, and back-and-front tension on the strip. MS (4a)

Rolls for Hot Rolling. W. Trinks. *Blast Furnace & Steel Plant,* Vol. 21, Dec. 1933, page 643. Reviews several fundamentals. Slip between rolls and bar produces wear. The harder a roll the less it wears. However, the increased brittleness results in fire cracking. Attempts to produce, by inexpensive alloying elements and heat treatment, a material which resists both wear and fire cracking have been unsuccessful. Judging wearing quality of different sets of rolls by comparison of the tonnage rolled under similar conditions is open to criticism. MS (4a)

Small Hot-Finished Seamless Tubing Made in New Mill. *Steel,* Vol. 92, Jan. 2, 1933, pages 88-89. Reviews advancements made in rolling-mills and accessory equipment during 1932. MS (4a)

Development in Rolling-Mill Trains (Entwicklungslinien der Walzenstrassen) J. Puppe. *Stahl und Eisen,* Vol. 53, Mar. 16, 1933, pages 265-270; Mar. 23, 1933, pages 300-305. The main lines in the development of rolling mill trains are discussed and various layouts illustrated. SE (4a)

Rolling Experiments with Carbon and Silicon Alloyed Steels at Medium Temperatures (Walzversuche an Kohlenstoff- und siliziumlegierten Stählen bei mittleren Temperaturen) A. Pomp & W. Lueg. *Mitteilungen aus dem Kaiser-Wilhelm-Institut für Eisenforschung,* Vol. 15, No. 8, 1933, pages 87-97. Steel is usually rolled either hot at temperatures from 700° to 1300° C. or cold at room temperature. In order to study the behavior of steel when rolled at the intermediate temperatures from 20° to 700° C. 4 C steels and 2 Si-alloy steels were rolled and the rolling pressure, changes of the dimensions of the material, and energy consumption measured and the mechanical properties of the rolled bars examined at room temperature. Compared with cold-rolling, a considerable increase of the resistance against deformation takes place up to 400°-600° C., beyond this temperature this resistance decreases again. At 100° C. a weakly pronounced minimum was observed. Similar conditions were stated for broadening and energy consumption. The microscopic examination shows an increasing deformation of the ferrite grains with temperatures up to 700° C. Rolling in this temperature range will, therefore, have no practical value except in the case of high Si alloys, as for instance transformer sheets which cannot be cold-rolled on account of their brittleness. Ha (4a)

Forging & Extruding (4b)

A. W. DEMMLER, SECTION EDITOR

On the Possibility of Producing Larsen Steel Piling at Dnieprostal Plants. A. Vinogradov, I. A. Nachalny & L. I. Fomichev. *Domez,* No. 4, 1933, pages 1-14 (In Russian). Detailed data on the design of passes required for production of Larsen sheet piles in 9 passes including bending of the lock in place by the same rolls. (4b)

Machines for Hot-Pressing Non-Ferrous Alloys. (Maschinen zum Warmpressen von Nichteisenmetallen.) O. Kühner. *Zeitschrift für Metallkunde,* Vol. 25, Apr. 1933, pages 88-93. A detailed description illustrated by diagrams and photographs. RFM (4b)

Forging. (Forgeage.) L. Faure. *Arts-et-Métiers,* Vol. 85, July 1932, pages 247-256. General survey of forging process. (1) Forge ingots. Shapes and sizes are dealt with. For special purposes all the surface defects such as pin holes are removed by turning, milling or chipping. Ends of ingots are cut off to eliminate piping and segregation. Processes (Rimer, Gütehoffnungshütte, Harmet) for reducing piping and to lessen length of lost portion at upper end of ingots are given. (2) Ingot heating furnaces are described. Heating requires special care: For instance, big ingots of more than 5 tons must be progressively heated up to 500° C. in order to go slowly through the blue brittle temperature range when cracks are liable to occur, then heating can be made rapid up to forging temperature. (3) Power of presses and hammers is explained as well as best conditions of operating those machines for reaching maximum efficiency. FR (4b)

Elimination of Pipe and Segregations in Ingots by Dechenne Method. (Elimination de la retassure et de la ségrégation des lingots par le procedé Dechenne.) A. Dechenne. *Revue de Métallurgie,* Vol. 30, Jan. 1932, pages 11-20. Forging blanks for wheel tires are cut from large ingots cast with hot tops. The center part of them is punched out removing with it all pipe and segregations. JDG (4b)

Forgeability of Steel. O. W. Ellis. *Metal Progress,* Vol. 22, Sept. 1932, pages 19-23. Abstract of a paper for the Buffalo Convention, A.S.S.T., Oct. 1932. Agreement between the work published by Robin in 1910, and work which the author published in 1924 and 1926 regarding the forgeability of steel is pointed out. In this work it was found that energy required to deform similar-shaped bodies a given percentage will vary as the volume of the bodies. The agreement between the two investigators points to the soundness of the methods of investigation. The equipment used in obtaining the present data is described. The forgeability of 3.5% Ni steel of various C contents was compared with a 0.68% C, plain C steel as to forgeability. Ni decreased the forgeability of medium C steel, but has little effect on low C steel. Cr reduces forgeability of medium C steel, possibly both elements have more effect at high temperatures than at low. Methods of manufacture are also without effect, shown by 5 different bars of the same C content. The various effects are presented in 6 graphs to show relations between energy of blow, temperature and percentage reduction. A method of determining energy required for a definite percentage reduction is presented. WLC (4b)

Automatic Forging Methods Perfected; Heat Control Applied to Furnaces. *Steel,* Vol. 92, Jan. 2, 1933, page 89. Reviews advances made in forging practice during 1932. MS (4b)

Machining and Forging Allowances for Forgings (Bearbeitungszugaben und Schmiedetoleranzen für Freiformschmiedestücke) G. Wollenweber. *Maschinenbau,* Vol. 11, Apr. 7, 1932, pages 149-152; May 5, 1932, pages 193-195. Wants to put up terms of reference for the determination of machining allowances and forging tolerances. Based on 4000 practical observations. These tolerances are functions of the length and the cross section of the pieces. Diagrams show the ± tolerances belonging to varying machining allowances and the machining allowances belonging to the varying dimensions of the finished pieces as they were observed in practical cases. Formulae are given and practical examples are figured out and illustrated. Whether harder material (above 60 kg./mm.^{2}) requires more allowance for machining is not decided. RV (4b)

Reducing Nitrided Die-Steel Costs. GLYN POWIS. *Metallurgia,* Vol. 9, Dec. 1933, page 38. Recommends use of nitrided inserts and scrapping of inserts rather than resinking. For some dies a deep case must be produced. JLG (4b)

Latest Diemaking Practice Used in a Chinese Plant. *Machinery,* New York, Vol. 39, Mar. 1933, pages 470-471. Describes practice, and gives cost of hard-facing dies with Stellite. Process said to increase life fourfold without adding to cost. RHP (4b)

Reconditioning of Old Splice Bars in Own Shop (Aufpressen alter Laschen in eigner Werkstatt) STRUCK. *Verkehrstechnik,* Vol. 50, July 20, 1933, pages 354-355. Detailed cost sheet for outside order and repair job in own shop. The expenses were cut down from 82 Pfennig/fish-plate to 23 pfennig a piece. Furnace employed and specially shaped drop hammer and anvil are illustrated. WH (4b)

Fluid Die Practice. HARRY SHAW. *American Machinist,* Vol. 76, Nov. 9, 1932, pages 1120-1123. A hydraulic method for bulging metals is described which in several respects is superior to other methods of forming unusual shapes as for instance spinning, rolling, pressing, etc. It is claimed the dies are cheaper and last longer, forms impossible by other methods can be obtained and that stretching attacks material more uniformly. Oil and water are generally used for producing hydraulic pressures. Examples of various shapes made by this process are illustrated. Ha (4b)

An Extrusion Problem. *Metal Industry,* London, Vol. 41, Nov. 18, 1932, pages 487-488. Certain methods used in the rubber trade for shaping by extrusion might be applied advantageously to non-ferrous metals with certain modifications in the machinery which is described; suggestions for it are made. Ha (4b)

Cold Working (4c)

Stamping and Forming of Mild Steels. CHESTER B. LORD & C. W. HINMAN. *Metal Stampings,* Vol. 6, Dec. 1933, pages 276-278. Discusses properties of mild steels used in forming and fabricating operations. There are 11 tempers ranging from annealed to extra spring hard. General Motors has 8 tempers ranging from soft drawing anneal to spring hard. S.A.E. 1010 is the steel usually used for drawing. Cold-rolled strip is preferable for deep drawing, but has a disadvantage in its tendency to age harden. A die properly set for a given temper will not produce a satisfactory part from steel 1 temper harder. Die clearances that are correct for box annealed steel will not do for normalized steel. Outlines the contents of a specification for mild steel. MS (4c)

Sheet and Strip Copper Alloys for Press Forming. CHESTER B. LORD & C. W. HINMAN. *Metal Stampings,* Vol. 6, Aug. 1933, pages 212-214. Gives chemical composition and physical properties of Cu and brasses for stamping, forming, and deep drawing operations. "Cartridge brass" (70% Cu, 30% Zn) is standard with most firms for deep drawing. MS (4c)

Stamping and Forming of Stainless Steel. CHESTER B. LORD & C. W. HINMAN. *Metal Stampings,* Vol. 6, Sept. 1933, pages 229-230. Describes properties of rust-resisting steels, particularly 18-8 Cr-Ni steel. Any form or shape may be drawn from this steel. Labor cost of producing drawn parts is about twice that for ordinary steel, 25% more power is required, and the dies last only ½ as long. Annealing after each operation is necessary, sometimes at 1950° F. and at other times only to 1350° F., depending upon severity of drawing operations. Before annealing, parts must be scoured thoroughly with beach sand to remove lubricant. After annealing, they are pickled in a 15% HCl solution and then in a 10% HNO_3 solution, and again scoured with beach sand. Spinning requires about 5 times as much labor as ordinary steel. Drawn or spun parts should not be left over night in an unannealed state. Polishing requires about 10 times as much labor as ordinary steel. No. 60, 120, and 200 grain abrasives are used in 3 steps. Ordinary polishing rouge which usually contains S should not be used as the S is injurious to the Cr-Ni steel. MS (4c)

Flying Shears (Fliegende Scheren) FRITZ CHRIST. *Stahl und Eisen,* Vol. 53, Jan. 19, 1933, pages 78-79. A few constructive details of arrangement in the continuous mill, mode of operation and drive with air or steam are described. Ha (4c)

109° Below Zero, An Ideal Temperature for Certain Metal-Working Operations. CHARLES O. HERB. *Machinery,* N. Y., Vol. 39, Jan. 1933, pages 305-309. Dry ice is used in the metal-working industry for contracting metal parts to facilitate their assembly into other pieces, for keeping Al-alloy rivets in an annealed state until used, for hardening certain steels by cooling them to abnormally low temperatures. Cylinder liners are coated with thin oil and shrunk with dry ice, then placed in cylinder blocks and at normal temperatures give a tight fit. The oil coating prevents hoar frost. Annealed Al rivets "age" rapidly at normal temperatures. At extremely low temperatures this does not take place. Airplane manufacturers use dry ice for this purpose. Corrosion resistant steels are hardened with dry ice. RHP (4c)

A Note on the Effect of a Backward Pull Upon the Tension Required to Draw Wire. F. C. THOMPSON. *Iron & Steel Institute, Advance Copy* No. 15, Sept. 1933, 5 pages; *Wire & Wire Products,* Vol. 8, Dec. 1933, pages 400-401; *Iron & Coal Trades Review,* Vol. 127, Oct. 20, 1933, page 599. A reverse tension in a wire being drawn increases the tension necessary to pull the wire through the die and the relationship between the 2 tensions is strictly linear. In drawing a mild steel the tensions were given by: $P = 58.5 + 0.685 W$, where P is the forward pull in lb. and W the backward pull in lb. 3 references. Ha + JLG (4c)

Steel Wire Drawing. RICHARD SAXTON. *Engineering,* Vol. 135, June 2, 1933, pages 608-609. Wire rod is converted into wire by drawing the material through a hole in a tapered steel die. A solid lubricant is used, composed of a small percentage of olive or palm oil mixed with a soap compound. Single-hole blocks are used for drawing high strain and winding-rope wire but for other types of wire the material can be reduced in from 2 to 6 passes at one operation. Tests made on the muriatic acid cleaning solution show that by suspending the material about 1 in. below the surface, it is cleaned more quickly, the action of the acid is more even, and the life of the acid is increased. The acid gives greater efficiency if kept in a state of agitation and if heated 20°-40° C. above the atmosphere. The surface water in the lime tank to the depth of 18 in. should be syphoned off and fresh water replaced just before use every day. Every 3 months the lime tank should be emptied and new lime used. LFM (4c)

Wire-Drawing Dies. R. SAXTON. *Metal Industry,* London, Vol. 43, Aug. 25, 1933, pages 169-170. The shaping of dies is discussed; for producing easy slip with minimum wear the following drawing angles have been found efficient in practice:

Al and Ag	16-18°, 1/10 of diameter cylindrical
Cu	14-16°, 1/5 of diameter cylindrical
Brass and Bronze	10-12°, 1/3 of diameter cylindrical
Fe and mild steel	8-11°, 1/2 of diameter cylindrical
High strain, acid steel	5-7°

The best lubricant, especially for steel is the so-called wire drawer's soap. Methods of making steel dies, stone dies and metallic stone dies are described. Ha (4c)

Side Line on Steel Wire Manufacture. J. DENNIS ROBINSON. *Iron & Coal Trades Review,* Vol. 126, Mar. 24, 1933, page 455; Mar. 31, 1933, pages 494-495. The essential operations of wire drawing are reviewed and present methods of rolling, cleaning and testing discussed. The steel used for wire drawing must be clean as defects which are negligible in roll finished material may be fatal in wire. Open-hearth steel is now fully equivalent to Bessemer steel. Microscopical investigation has done much to improve quality of wire and to help in solving wire drawers' problems. Ha (4c)

New Light on Wire-Drawing. F. C. THOMPSON. *Wire & Wire Products,* Vol. 8, Mar. 1933, pages 69-72, 93-94; Apr. 1933, pages 101-103. Mechanism of wire-drawing in its theoretical and practical phases was investigated; first installment gives a brief history of wire drawing and present methods of drawing through dies. Tension of drawing is independent of speed; relations of tension needed to effect a given reduction through a die of constant contour to mechanical properties of material being drawn are discussed at length. Power required depends on lattice construction, face-centered cubic arrangements (such as non-ferrous metals) requiring different power than body centered lattices (such as in ordinary steels). Materials and shaping for dies are discussed, WC, sintered with small amounts of Fe, Ni, Co are now most frequently used. Experiments suggested hard soap to be best lubricant, for non-ferrous wires; however, liquid or greasy lubricants are at present preferred. These are invariably better than soap when water is allowed to heat up to boiling point due to insufficient cooling. Conical taper of die influences power consumption, an angle between 5° and 5½° showed a minimum; this again depends to a certain extent on amount of reduction, but for reductions from 20 to 35% an angle between 3° and 6° gives minimum power consumption. Influence of surface finish of die is discussed. Angle of taper of die is not changed by surface conditions. The pull for drawing can be considerably reduced by rotating the die during drawing, while a stationary die required 82 lbs. pull for a cupro-nickel wire; this diminished to 61 lbs. at 50 r.p.m., to 51 lbs. at 160 r.p.m. and at 3300 r.p.m. 21 lbs. only were needed. Above 2000 r.p.m. however the increase was very small. Besides reducing the pull, a rotating die seems also to improve the torsional strength. High rate of reduction is conducive to diminishing power demand, irrespective of lubrication. The temperature of the lubricant has a further great importance; most lubricants seem to increase output with increasing temperature up to 100° C. Ha (4c)

Reducing the Cost of Cutting Large Holes in Solid Metal by Trepanning. R. R. WEDDELL. *Machinery,* N. Y., Vol. 39, July 1933, pages 694-696. Process used largely in boiler shops, shipyards, and railroad shops on plate work. Recommended cutting speeds for trepanning various metals:

Metals	**Feet per minute**
Gray cast iron	60
Soft machine steel	100
0.30 to 0.40% C steel	75
Alloy steels	60
Bronze	100
Brass	200
Cu	200
Al	300

From these values, the approximate revolutions per minute of the cutter can be determined by the following formula:

$$\text{R. P. M. of cutter} = \frac{\text{Cutting speed (feet per minute) x 4}}{\text{Diameter of Cutter (inches)}}$$

A reaming head should follow the trepanning cut to finish a large hole accurately. RHP (4c)

Change of Magnetic Induction at Constant Field Strength by Cold-Working and the Recovery by Heating (Ueber die Aenderung der magnetischen Induktion bei konstanter Feldstärke durch Kaltbearbeitung und die Erholung beim Erhitzen) G. TAMMANN & H. J. ROCHA. *Annalen der Physik,* Series 5, Vol. 16, Apr. 1933, pages 861-864. The influence of cold-working of Fe is much greater on the magnetic induction than on the electric resistance, on Ni a still greater influence on the induction is noticed than on Fe. The recovery for Ni lies in a higher temperature range than for Fe. The recovery of magnetic induction coincides in Ni with recovery of hardness, in Fe with recovery of electric resistance. Results are shown in curves. Ha (4c)

Recovery from Cold-Working in Iron and Nickel (Ueber die Erholung von der Keltbearbeitung) G. TAMMANN & K. L. DREYER. *Annalen der Physik, der Physik,* Series 5, Vol. 16, Mar. 1933, pages 667-679. The changes of temperature coefficients, temperatures required for the recovery of the electric resistance, and the potential energy retained in the metal during cold-working were determined. Fe and Ni show greatly different behavior from Cu, Ag and Au. Ha (4c)

Sizing and Resizing Carbide and Diamond Dies for Copper Wire Drawing. J. J. KEHOE & F. D. RUHL. *Wire & Wire Products,* Vol. 8, Oct. 1933, pages 305-308, 330. Describes methods and processes used by the General Electric Company and the manner of keeping track of the whole life of a die. Ha (4c)

Recovery of the Electric Resistance of Binary Solid Solutions of Copper, Silver and Gold from the Results of Cold-Working (Die Erholung des elektrischen Widerstandes binärer Mischkristalle des Kupfers, Silbers und Goldes von den Folgen der Kaltbearbeitung) G. TAMMANNN & K. L. DREYER. *Annalen der Physik,* Series 5, Vol. 16, Mar. 1933, pages 657-666. Additions to Cu, Ag and Au forming solid solutions may increase or reduce the increase of electric resistance by cold rolling, but always increase the specific resistance. The 3 metals behave very similarly as they belong to the same group in the periodic system. Ha (4c)

Recovery of Electric Resistance and Hardness of Binary Iron Solid Solutions from the Results of Cold-Working (Die Erholung des elektrischen Widerstands und der Härte binärer Eisenmischkristalle von den Folgen der Kaltbearbeitung) G. TAMMANN & V. CAGLIOTI. *Annalen der Physik,* Series 5, Vol. 16, Mar. 1933, pages 680-684. The curves of the temperatures at which the electric resistance and hardness resume their original values after cold working are determined for pure Fe and the alloys with Al, Si, V, Cr, Co, Ni, Mo and W. The resistance curve usually shows 2 inflection points. Ha (4c)

Hard-Facing Reduces Die Costs. GEORGE SYKES. *Metal Stampings,* Vol. 6, Nov. 1933, pages 261-263; Dec. 1933, page 279. Presents typical examples of the application of hard facing to stamping, trimming, piercing, and forming dies. The life of the dies was increased and the cost was reduced. MS (4c)

Deep-Drawing of Rustless Steels (Il Lavoro d'Imbutitura cogli Accial antiruggine) C. MAURELLI. *L'Industria Meccanica,* Vol. 15, Nov. 1933, pages 863-865. Discusses paper by Sommer in *Iron Age* (*Metals & Alloys,* Vol. 4, Nov. 1933, page MA 361) and gives some formulas for calculating the possible deepening of different materials. Ha (4c)

Tool Steels for Press Operations. A. R. PAGE. *Metal Industry,* London, Vol. 43, Dec. 1, 1933, pages 531-533. Quality of steels for press operations is discussed for each of the 4 divisions: 1. hot and cold drawing and forming, 2. blanking and shearing, 3. piercing, 4. heading and riveting. The particular points to be observed in treating steels and the compositions suitable for any of these divisions are considered in detail; instructions for heat-treatment are given. Ha (4c)

Influence of Annealing Temperature on the Drawability of Steel Wire (Einfluss der Glühtemperatur auf die Ziehbarkeit von Stahldraht) A. POMP & B. ZAPP. *Mitteilungen aus dem Kaiser-Wilhelm-Institut für Eisenforschung,* Vol. 15, No. 9, 1933, pages 107-118. 6 different steels were annealed at 5 different temperatures and drawn with reductions of 8-47% for each pass; the pull required, tensile strength and elongation were measured and from the results the best annealing temperature was determined. The results are given in detail in curves and tables and micrographs are reproduced. Ha (4c)

Punching and Drilling (Poinconnage et Percage) *Science et Industrie,* Vol. 16, Oct. 1932, page 448. 2 examples are given which show that it is possible to save time by substituting drilling operation for punching operation in manufacturing plate gussets with holes. FR (4c)

Machining (4d)

H. W. GRAHAM, SECTION EDITOR

Use of X-Ray on Depth of Cold Work by Machining. L. Thomassen & D. M. McCutcheon. *Mechanical Engineering*, Vol. 56, Mar. 1933, pages 155-157. Paper presented at annual meeting of A.S.M.E., New York, Dec. 4-9, 1933. By directing a beam of X-rays containing the molybdenum α_1, α_2 doublet against a flat piece of metal under an angle of 10° and photographing the diffracted ray, a surface layer of thickness less than 0.0001 in. will produce practically all the diffracted rays. This gives a powerful means of investigating the structure of thin layers, even when they change quite rapidly in character from the surface inward. Authors define depths of cold working as distance below surface where effect of lattice deformation is no longer noticeable in the X-ray diffraction picture. Determined as follows: After annealing, an X-ray picture is taken of the sample as a record of the structure. The machining operation is then carried out under carefully controlled conditions, the machined surface is etched to remove a definite thickness of material, and a new X-ray picture taken, which is compared with the first. If the two are identical, the new surface produced by etching is below the depth of cold working. If effect of work is evident, procedure is repeated in small steps until a picture is obtained which shows the same structure as the first. The total thickness of material removed by etching is then the depth of cold working. Grinding instead of etching produces complete fragmentation of surface and also comparatively deep cold working, hence is out of the question. It is difficult to find exactly where the last trace of cold work disappears, but accuracy will in all cases be greater than that of the old methods. From the pictures it also is possible to estimate depth of fragmentation as indicated by disappearance of continuous rings. Advantage of method is its directness. All hardness tests are indirect, since they measure one of the effects of cold working—namely, work hardening which varies from one material to another. Determination of depth of cold working by hardness measurements on a material which work hardens little must obviously be inaccurate. Method outlined was tried for a 70-30 brass (milling); and a leaded free-machining brass containing 60.7% Cu, 35.0% Zn, and 3.2% Pb (turning). Summary of results: (1) Depth of cold working increases more rapidly with increase in feed than with increase in depth of cut, for the tools and materials used. (2) Linear connection is found between depth of cold working in turning as a function of the cutting force. (3) Increase in depth of cold work of over 300% is found on using a dull cutter instead of a sharp one in milling experiments. This depth would indicate a great force expended on cutting. A strong orientation of the crystalline structure was produced, similar to what occurs on cold rolling. This effect was observed even at a depth of 0.0115 in. below the machined surface. (4) Increase in speed of milling from 154 to 342 r.p.m. does not increase the depth of work appreciably. MFB (4d)

Machining of Antifriction Alloys of a Lead Base and High Content of Cu (Note sur l'Usinage des Alliages antifrictions à Base de Plomb et à haute Teneur en Cuivre) A. Ricard & H. Ackermann. *Cuivre et Laiton*, Vol. 6, Oct. 15, 1933, pages 471-473. Best results for machining these alloys have been obtained with tools of tungsten carbide (Widia, Carboram) and a maximum speed with a minimum feed and depth of chip. The most suitable shapes of tools are illustrated. Ha (4d)

Find Correlation of Design and Production Essential. *Steel*, Vol. 91, Oct. 10, 1932, pages 32, 34. Résumé of papers at production meeting, Society of Automobile Engineers, Buffalo, N. Y., Oct. 3, 1932. JN (4d)

Workability of Steel and Cast Iron (Bewerkbaarkeid van staal en gietijzer) *Polytechnisch Weekblad*, Vol. 27, Mar. 2, 1933, pages 139-141. The 3 principal methods of determining the working properties under chipping tools are discussed and experimental results compiled in 3 tables mainly referring to investigations of Rapatz. WH (4d)

Report on the Heat Conductivity and Hardness of Carbon and High-Speed Steel, also the Durability of these Steels When Cutting Brass. Dempster Smith & Arthur Nield. *Proceedings Institution of Mechanical Engineers*, Vol. 123, Dec. 1932, pages 709-725. Published by the Cutting Tools Research Committee of the Institution of Mechanical Engineers. The research covers: 1. relative thermal conductivity of carbon and high speed steel, 2. initial and work hardness of tool steel at different temperatures, and the effect of repeated heatings for short periods at one temperature on the hardness, 3. initial and work hardness of the brass at different temperatures, 4. variation of the temperature at the cutting edge of the tool, with change in cutting speed and traverse, and 5. variation in durability of tools with change in cutting speed and traverse. Composition of the carbon steel tools was C. 1.28%; Mn. 0.28%; Si. 0.10%; Ni, 0.065%; P, 0.018%; and S, 0.005%. Hardened by heating to 820° C. and quenched in water. No reheating. High-speed tool steel composition: C, 0.65%; W, 13.08% Cr, 2.97%; V, 0.52%. Preheated to 800° C., transferred to a high temperature furnace at about 1,350° C. and held in this till the surface of the steel reached 1300° C. Cooled in air blast. Some tools received a secondary heat treatment at 420° C., and 580° C. Methods are described in full. Carbon steel conducts heat better than high-speed steel. Prolonged or repeated heating of carbon steel reduced the hardness. Since ordinary brass cutting temperatures range from 150° C-300° C. carbon steel tools will not wear as well as high speed steel which retains its hardness under prolonged or repeated heating. Brass composition: Cu, 70.44%; Zn, 26.81%; Pb, 2.20%; Fe, 0.36%; and a trace of tin. Hardness tests with the Herbert pendulum showed a constant time hardness of 9 up to 300° C.; constant initial scale hardness 3; final scale hardness 63 throughout. About 25% increase in hardness due to cutting. High-speed steel shows definite superiority to carbon steel in durability. Numerous charts give results in full. RHP (4d)

The Preparation of Car Journal Bearings. *Railway Mechanical Engineer*, Vol. 107, Sept. 1933, pages 323-325. Tests with bearings indicated that initial friction could be reduced from 50 to 90% by special methods of broaching, and that also excessive heating is avoided in this manner. Tests are described. Ha (4d)

New Machine Tools for Railway Shops. *Railway Engineer*, Oct. 1933, pages 315-317. Detailed description of Herbert milling and drilling machines and new types of motor-driven capstan and combination turret lathes. WH (4d)

Machining Marine Propeller Shafts. *Machinery*, London, Vol. 42, Sept. 21, 1933, pages 729-734. Discussion of machines and methods employed in machining heavy forgings involving pieces approaching 200 tons in weight. Shafts are usually forged from 0.32-0.34% C steel billets, and are heat-treated before entering the machine shop. Machining of shafts is explained by reference to a table listing the sequence of operations as conducted on an exceptionally large shaft. Kz (4d)

The Manufacture of Rapid Machining Steel. *Engineering*, Vol. 136, July 21, 1933, pages 58-59. Brief description with illustrations of the manufacture of "Phoenix" (standardized) rapid machining steel. It is a product of Steel, Peech and Tozer, a branch of The United Steel Companies, Ltd., Sheffield. The processes of its manufacture have been so standardized that its quality is unvarying. It can be machined at the highest possible speed with a fine finish. The C contents are high, S and Mn are at the limiting figures, P is normal, and it contains no Si. The structure is more uniform than that found in most free-cutting steels. The tensile properties are given in tables. See also illustrated article entitled "Phoenix Steel" in *Engineer*, Vol. 156, July 21, 1933, pages 58-59. LFM (4d)

Multi-Blade Cutting Tools. R. R. Weddell. *American Machinist*, Vol. 77, Aug. 16, 1933, pages 526-527; Aug. 30, 1933, pages 556-557. Design and use, power requirements, adjustments, feeds and speeds are discussed. Ha (4d)

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HEAT TREATMENT (5)

O. E. HARDER, SECTION EDITOR

1 **Heat Treatment of Aluminum Castings.** WIRT S. SCOTT. *Metal Progress*, Vol. 24, Sept. 1933, pages 21-24. Discusses factors entering into the acceptance tolerances and the recommendations of the metallurgist in regard to the heat treatment of castings. Variations in temperature in the charge from that at the controlling thermocouple and the possibility of keeping such variation within limits which will produce the desired results are discussed. The author describes a pit type electric furnace with forced circulation of atmosphere ahrough the charge which gives a maximum variation throughout the charge of ± 6° F. Results obtained in the heat treatment of casting of 95% Al, 5% Cu for high strength in this type of furnace are reported. WLC (5)

2 **The Heat-Treatment of Broaches.** WILLIAM E. SNOW. *Machinery*, N. Y., Vol. 39, May 1933, pages 584-586. Considers only C steel. Teeth should show a Shore scleroscope hardness of 84 to 89. A steel of about 1% C double-quenched, first in brine and then in oil will have the required hardness and strength. Hardening temperature is between 1425 to 1450° F. The brine quenching bath permits the use of a slightly lower temperature than plain water. Draw at a temperature of from 380 to 400° F. Considers design and straightening of broaches. RHP (5)

3 **Equilibrium Diagrams of Salts for Salt-baths. Part III, The Equilibrium Diagram of the Na_2CO_3-$BaCl_2$-KCl System.** TOMO-O SATO. *Kinzoku no Kenkyu*, Vol. 10, Oct. 25, 1933, pages 448-463. (In Japanese.) The dehydration temp. of $BaCl_2 \cdot 2H_2O$ was measured by means of thermobalance to be 60-150°, and the melting and transformation points of $BaCl_2$ were determined by thermal analysis to be 963° and 927° respectively. The thermal analysis was also carried out for binary and ternary mixtures of salts, Na_2CO_3, $BaCl_2$ and KCl. The binary equilibrium diagrams of Na_2CO_3-$BaCl_2$ and $BaCl_2$-KCl systems were constructed: in the former system, a compound, $BaCl_2 \cdot Na_2CO_3$, which decomposes into two insoluble liquid phases on heating at 730° is formed, while in the latter system, a compound, $2KCl \cdot BaCl_2$, which has definite melting point at 670° is formed; the diagram of the latter system obtained in the present work well coincides with that of a former investigator. In both systems eutectiferrous mixtures are formed. From the result of the thermal analysis for 62 ternary mixed salts, isothermal diagrams, sectional diagrams and a projectional diagram of the space model of this ternary system were constructed. There are two ternary eutectic and one peritecto-eutectic points in this ternary system. The two liquid reaction surface spreads out on the liquidus surface of the compound, $BaCl_2 \cdot Na_2CO_3$, widely. The process of crystallization of various mixtures belonging to the several fields is explained. TS (5) 4

Annealing (5a)

5 **Bright Annealing in Mixed Gas.** A. L. MARSHALL & MAYNARD AGENS. *Metal Progress*, Vol. 24, Sept. 1933, pages 32-34. Authors demonstrated that with equilibrium mixtures of gas no etching action will take place with exposure at temperatures below 650° C. for as long as 15 hrs. Possibility of oxidation of the steel by the action of CO_2 or water is easier of control. WLC (5a)

Notes on the Preparation of Lead and Lead Alloys for Microscopic Examination. BRINLEY JONES. *Institute of Metals, Advance Copy* No. 644, Sept. 1933, 3 pages; *Metal Industry*, London, Vol. 43, Sept. 22, 1933, page 270. Descriptive. Ha + JLG (5a)

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Bright Annealing (Das Blankglühen) *Deutsche Goldschmiedezeitung,* Vol. 36, Oct. 7, 1933, pages 435-437. Considers bright annealing in salt baths with special reference to a method utilizing pointed gas flames as heating medium. Salt bath is kept in motion by blowing in air through pipe at bottom of kettle. Material to be annealed is dipped in salt bath in a wire basket for a short time, then rinsed in water. Bright annealing of small articles by this method requires but 8-10 sec. Mixture of salts used is not given but melting point is about 520° C. Special method was developed for bright annealing wire below 1 mm. in diameter. Such wires are drawn through the pipe filled with heated steel tacks. Ends of pipe are cooled while middle section (about 50 mm. in length) is heated by gas burners. To avoid tacks from slipping in tube in direction of pulling 2 wires are simultaneously pulled through in opposite direction. GN (5a)

Experiences and Operating Results of a Gruenewald Annealing Furnace Installation. (Erfahrungen und Betriebsergebnisse mit einer Grünewald-Glühofenanlage) A. L. Schuhmacher. *Elektrowärme,* Vol. 3, Sept. 1933, pages 292-293. Comparison between electrically and lignite-fired furnaces of the box type for annealing strip steel was more favorable for the former both with respect to quality and time required; the time was much shorter, and the waste less. Installation and operation are described. Ha (5a)

Annealing of Alloy Steels. B. D. Sadovski & P. A. Trofimov. *Domez,* No. 7, 1933, pages 18-19. (In Russian.) Isothermic decomposition of austenite in quenched high speed steel was determined dilatometrically. Austenite decomposition range was 780°-720° C. Holding for a sufficient time causes complete decomposition of austenite, which is not affected by the rate of cooling above or below this range. For Cr-Ni steel the range is 660°-600° C. Hot rolled stock can be annealed rapidly by placing it for about one half hour into a furnace heated to the necessary temperature range for austenite decomposition. (5a)

Short-time Annealing of Aluminium Sheet and Strip in Continuous Electric Annealing Furnaces. H. Masukowitz. *Metal Industry,* London, Vol. 42, Apr. 21, 1933, pages 425-427. See *Metals & Alloys,* Vol. 4, Aug. 1933, page MA 256. Ha (5a)

Controlled Atmosphere Electric Furnace Bright Anneals Tubing. *Electrical World,* Vol. 102, Nov. 18, 1933, pages 668-669. Furnace rated at 180 kw. utilizes an automatically generated and maintained artificial gas atmosphere within the heating and cooling sections. Copper and brass tubing are annealed and the bright unoxidized surface on the finished product is preserved. The artificial atmosphere is obtained by partially cracking natural gas, mixing with illuminating gas in a closed chamber containing a controlled supply of air. Since the artificial atmosphere is lighter than air, little of it is lost by leakage, the chambers are much higher than the tops of the openings of the charging and discharging hoods. The control of the furnace is simple and largely automatic. CBJ (5a)

Technical Heating Processes for the Annealing of Sheet Iron Coils (Ueber Wärmetechnische Vorgänge beim Glühen von Bandeisen in Ringform) H. Schmid. Doctor's Thesis, Technische Hochschule Aachen, 1933. Paper, 6 x 8¼ inches, 33 pages. In the annealing of deep drawing sheet steel in the shape of rings which are stacked into a pile and lowered into an electric resistance furnace, the thermal conductivity of the pile of thin sheets is low. The furnace was automatically controlled from a pyrometer by the resistor windings so as to maintain 850° C. at that point, but not to exceed it for fear of overheating the outside of the rings to be annealed. Heating is continued till the temperature of the coldest part of the charge has reached 600° C. when the charge is removed to a slow-cooling chamber and the furnace recharged. With a charge of about 2 tons of sheet stock 1 mm. thick, the furnace took an average of 66 kw and 5 hrs. 10 minutes to anneal, using a total of 342 kwh. In order to speed up the annealing, 9 separators each containing about 30 lbs. of copper were interleaved in the pile. The high thermal conductivity of the copper caused the heat to drain rapidly from the outside to the inside and thus the automatic control fed energy to the furnace at a higher rate. With the copper separators the furnace took an average of 96 kw and only 3½ hours, using a total of 335 kwh, notwithstanding that the weight of the charge was increased by the weight of the separators, the actual steel charge being the same. The saving in radiation loss from the furnace during the shorter heating period balanced the energy needed to heat the copper itself. Thus, the efficiency was not decreased but the furnace output was materially increased. Observations were made on preheating of the charge and of the furnace top, by which a 10% reduction in energy consumption could be had. Tests on preheating plus the use of copper separators showed the advantages to be additive. The data are used in developing mathematical expressions and families of curves by which the furnace performance on charges of various weights and consisting of sheets of various sizes and thicknesses may be predicted. Curves showing the temperature of different portions of the charge at various stages of the heating cycle are given which clearly show the beneficial effect of the use of copper as a heat-equalizer. HWG (5a)

Hardening, Quenching & Drawing (5b)

Changes of Heat-Content During Tempering of Quenched Carbon Steels and Their Explanation (Ueber die Wärmetönungen beim Anlassen abgelöschter Kohlenstoffstähle und ihre Deutung) F. Staeblein. *Technische Mitteilungen Krupp,* No. 2, 1933, pages 37-39. The changes of heat-content occurring in a steel during tempering were measured quantitatively by a new, direct measuring method instead of by the difference between 2 measurements as before. For this purpose the familiar Saladin apparatus was somewhat modified so that a hardened and a neutral sample can be measured simultaneously. An electric auxiliary heating device is used to imitate the change in heat content. The first change was found from 100°-200° C. and corresponds to the transformation of the tetragonal into the cubic α-Fe lattice and to the formation of carbide molecules. The second change, from 200°-350° C. is caused by the transformation of residual austenite into a structure corresponding to the final condition of the first stage. The change of the third step from 250° to 450° C. is only indistinctly limited from the second step. The heat liberated here can be considered as crystallization heat of cementite. Recorded curves are reproduced. Ha (5b)

Quenching and Drawing Phenomena in Alloys. (Phénomenes de Trempe et de Revenu dans les Alliages) A. Portevin. *L'Usine,* Vol. 42, Aug. 17. 1933, pages 21-24; Aug. 24. 1933, pages 24-27; *Metal Industry,* London, Vol. 42, May 12. 1933, pages 491-493; May 19, 1933, pages 521-524; May 26, 1933, pages 543-545. Cause and effects of quenching and tempering phenomena in steel and alloys, physico-chemical, structural and interior elastic modifications and the respective states of equilibrium are discussed. Physico-chemical equilibrium is defined by the equilibrium diagram; structural equilibrium is that which would be realized by the complete separation of phases whereby each phase forms only one crystalline individual and stable elastic equilibrium exists when all internal stresses are absent. The first and third equilibrium states can be obtain in practice. the second is an ideal state. All materials in a quenched state are out of equilibrium and each treatment which removes the equilibrium has a quenching effect; inversely, each treatment which brings a material closer to an equilibrium state has a tempering effect; this applies to all three kinds of equilibrium. Methods to investigate these states (mechanical tests, X-ray spectrograms, heat tests, etc.) are described and the establishment of laws for the various conditions and possibilities of tempering is attempted. Generally valid explanations have not yet been found. 11 references. Ha (5b)

Hardening and Drawing Ford Drive Shafts by Improved Methods. J. B. Nealey. *Machinery,* N. Y., Vol. 39, Mar. 1933, pages 472-473. Describes and illustrates equipment and operations. RHP (5b)

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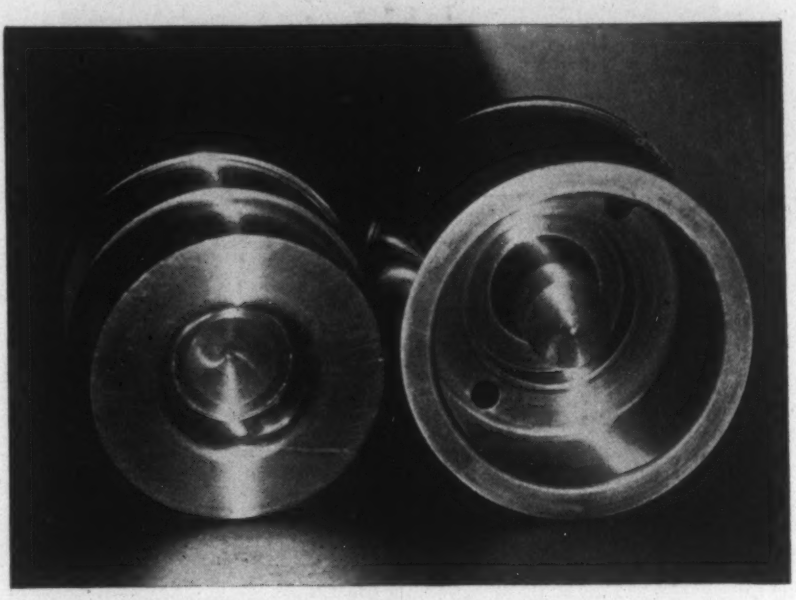

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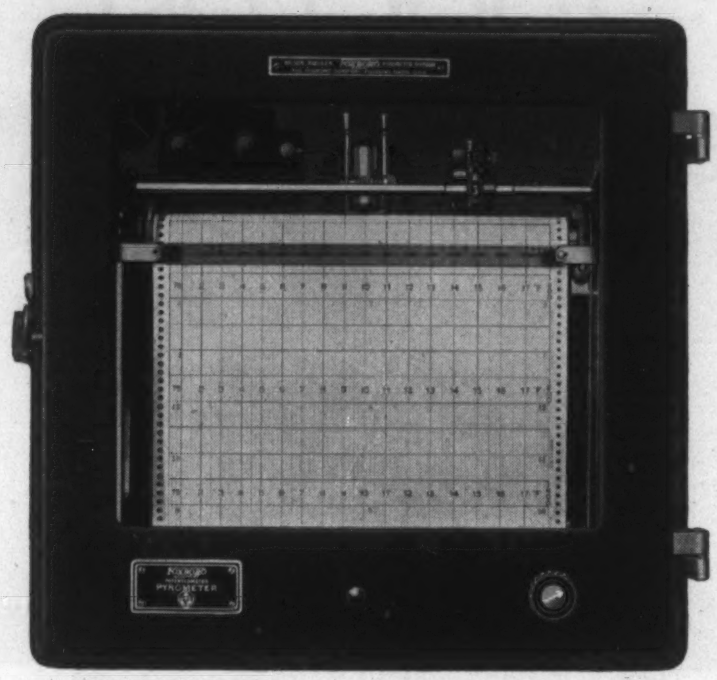

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Heat Treating Steel Wheels. *Heat Treating & Forging,* Vol. 19, Sept. 1933, pages 12-13, 17; Oct. 1933, pages 40-41. **Car Wheels Are Heat Treated with Synchronized Equipment.** *Steel,* Vol. 93, Aug. 14, 1933, pages 25-27. **Precision Control Features Heat Treating of Wrought Steel Wheels.** *Iron Age,* Vol. 132, Aug. 17, 1933, pages 24-25, 62. Bethlehem Steel Co. has recently completed at its Johnstown, Pa., plant a unit for the heat-treatment of wrought-steel wheels in which movement and heating are automatically and precisely controlled. Comprises an oil-fired, circular, continuous heating furnace with rotating hearth; a "floor-type" charging and withdrawing machine; 2 motor-driven quenching units; a drawing furnace similar to the heating furnace; cooling pits; and auxiliary equipment. Annular hearth of heating furnace is 7 ft. 3 in. wide with a mean diameter of 32 ft. and has a capacity of 54 wheels of 36 in. diameter. Furnace is divided into 4 zones. In the first, into which cold wheels are placed, temperature is increased from room temperature to 1200° F. In the second, temperature reaches 1400° F., while in zones 3 and 4, a constant temperature of 1600° F. is maintained. Quenching unit embodies 2 disks between which wheel is clamped and rotated, H_2O being sprayed only on the rim. Hearth of drawing furnace is 7 ft. 3 in. wide with a mean diameter of 21 ft. and has a capacity of 30 wheels of 36 in. diameter. It is divided into 3 zones having a constant temperature of 950° F. Capacity of plant is 15 wheels of 36 in. diameter per hour. MS + VSP (5b)

Heat Treatment of Permanent Magnets. P. M. *Machinery,* London, Vol. 42, Apr. 27, 1933, pages 101-103. The magnetic qualities of the steel will depend upon the thermal treatment to which it is subjected during the process of magnet-fabrication. Compositional and structural homogeneity is essential. Three varieties of magnet steels are principally employed: W, W-Cr, and Co steel. The composition of a good W magnet steel is given as follows: 5.5-6.5% W, 0.35% Cr, 0.65-0.75% C, 0.20-0.40% Mn, 0.20% Si, S and P 0.035% max. (Hardness expressed in Vickers pyramid diamond VD/H30 = 350). Forging (750° C.) and annealing (790° C.) of W steel magnets are discussed as well as hardening after preheating to 630°-660° C., in a hardening furnace at 840°-850° C. After water-hardening the Vickers hardness should not be less than VD/H30=680. W-Cr magnet steel contains: 0.67-0.75% C, 0.20-0.35% Mn, 0.05-0.25% Si, 0.03% P, 0.05% S, 5.5-6.0% W, 0.55-0.75% Cr. VD/H30=300. Forging temperature is 950°-1150° C. Annealing is carried out by heating to 730°-750° C. This treatment should give a hardness of VD/H30=260. After heating to 820°-830° C. and water-quenching a hardness of VD/H30=650 should be obtained. The 3 principal Co magnet steels are given in the table and have a hardness of VD/H30=565. The effect of the Co addition is to render the solutions of the carbides somewhat sluggish; and to attain a uniform distribution of the carbides so as to produce a steel in the best condition to give the highest magnetic efficiency, is the object of the heat-treatment process. Details of the somewhat involved thermal treatment prior to magnetizing are given.

C	Mn	Si	S P	W	Cr	Mo	Co
1.0 -1.20	0.15-0.25	0.10-0.25	0.04-0.03	....	8.5-9.5	1.25-1.75	8.5- 9.5
1.0 -1.10	0.15-0.25	0.10-0.25	0.04-0.03	....	8.5-9.5	1.25-1.75	15.0-16.0
0.80-0.95	0.25-0.45	0.10-0.25	0.04-0.03	4.0-6.0	4.5-5.5	....	34.0-36.0

Kz (5b)

Torch Hardening of Gear Teeth. NORMAN E. WOLDMAN. *Machinery,* N. Y., Vol. 39, Feb. 1933, pages 379-382. The Westinghouse-Nuttall gear plant has developed and successfully used a localized heat treatment process for gear teeth. This is known by the trade name of Nuttall "E.P." heat treating process. Plain C steels can be surface hardened to 400-500 Brinell, C-V steels to 450-550 Brinell, and alloy steels up to 600 Brinell. Surface hardening is possible with negligible distortion. Hardening can be localized. Depth of hardening is great for large sections, the core is unaffected and will retain the high ductility of the original normalized or annealed structure. May be applied to any C or alloy steel. Quenching medium may be changed. Gives no surface checks or quenching cracks. Applicable for heavy work. Parts, if accessible, can be hardened on the assembled machine. A table shows the tensile strength, yield point, elastic limit, elongation, reduction of area, Brinell hardness, and Izod impact of medium C forgings (0.4-0.5% C), medium C steel castings (0.35-0.45% C), C-V steel forgings (0.4-0.5% C, 0.15-0.25% V). Physical properties of the core and of the outer fibers are given. RHP (5b)

The Employment of Proper Quenching Oils in Electrically Heated Furnaces (Ueber die Verwendung richtiger Abschrecköle bei elektrizch Beheizten Oefen) K. KREKELER. *Elektrowärme,* Vol. 3, July 15, 1933, pages 220-221. To secure a good surface condition of the material during heat treating, especially in bright annealing, special oils are used which prevent oxidation and do not form any residues in salt baths; they have to be selected with different viscosities according to the material. Ha (5b)

Kinetics and Thermochemistry of Tempering in Hardened Carbon Steels (Kinetic und Thermochemie der Anlassvorgänge in gehärteten Kohlenstoffstählen) G. NAESER. *Zeitschrift für technische Physik,* Vol. 14, No. 6, 1933, pages 230-232. Tempering phenomenon is investigated in its relation to the quantities of heat liberated as the latter is equivalent to the converted material during the process. The paper must be referred to for details in determining heat quantities and course of the 3 tempering stages, i.e. first conversion of martensite with segregation of C, second conversion of residual austenite, and thirdly, formation of cementite. Ha (5b)

Aging (5c)

The Age Hardening Characteristics of Some Copper-Nickel-Silicon Alloys. B. W. GONSER. Doctor's Thesis, Harvard University Engineering School, 1933. 146 typed pages, 103 references. Not published, can be consulted at the library of the Harvard Engineering School. Alloys containing 1.8% Ni, 0.4% Si (2% Ni_2Si); 2.4% Ni, 0.6% Si (3% Ni_2Si); and 4.4% Ni, 1% Si (5% Ni_2Si) 5.3% Al were studied. The times and temperatures for the solution anneal were determined. In specimens ½″ long x ¾″ diameter, the 2% Ni_2Si alloy retained complete solid solution on air cooling and gave the same hardness on subsequent precipitation hardening treatment as it did when water quenched before precipitation. Time-temperature-hardness aging curves are given. The 2% Ni_2Si alloy could be hardened to 180, the 3% to 200 and the 5% + 5% Al to 220 Brinell.

Material that had been overaged at high temperatures above those ordinarily used, but below the solubility temperature of Ni_2Si, i.e., in which agglomeration would be considered to be quite advanced on the usual theories of aging, when cooled and reheated at the normal precipitation hardening temperature, regained considerable of their hardness. This is not readily explainable by the usual theories.

Some of the hardness produced by cold working the material in the solution annealed condition appears to be due to age hardening induced by the cold work. Such material shows more rapid precipitation hardening than unworked material.

No season cracking tendency was found in any of the alloys in any condition under the mercurous nitrate test.

Torsional tests at elevated temperatures gave stepped diagrams which aided in the interpretation of the aging phenomenon. Electrical conductivity tests indicated a difference in the mechanism of aging induced by cold work and that produced by heating.

Dilatometric tests indicated that a slight contraction occurs during the formation of Ni_2Si. As usual in precipitation hardening systems the microscope showed no visible precipitate in fully hardened specimens, but Ni_2Si appears in over-aged specimens in which agglomeration has occurred.

Laué X-ray examination revealed lattice strain in the aged alloys. X-ray diffraction patterns showed faint lines that may be due to Ni_2Si in over-aged material.

It is concluded that the aging hardness is primarily due to lattice distortion rather than to keying of slip planes by precipitated Ni_2Si. HWG (5c)-B-

Malleableizing (5d)

The Malleablization of White Cast Iron. R. SCHNEIDEWIND & A. E. WHITE. *Engineering Research Bulletin,* No. 24, *University of Michigan,* Aug. 1933, pages 1-73. Price $1.00. Changes occurring during tranformation of white iron to malleable iron were studied. Graphitization of white Fe begins at the grain boundaries of the austenite crystal usually at an interface between austenite and free cementite. In the first stage, annealing above Ar_1, a nucleus-forming force and a diffusion force exist, the former probably due to the simultaneous reaction $Fe_3C \rightarrow 3Fe + C$ and $Fe_3Si_2 \rightarrow 2FeSi + Fe$, the latter due to deposition of C atoms resulting from solution of carbides in austenite. In the second stage, annealing below Ar_1, diffusion force only is present. The number of nuclei formed during graphitization is influenced by the soaking temperature, fluctuations of temperature during annealing and the melting and casting practice in the manufacture of the Fe. Graphitization reaction follows the law of mass action as represented by $\log (C\text{-}C_e)/(C_o\text{-}C_e) = K\theta$, where C is combined C content at any time θ, C_o total C content, C_e combined C content at equilibrium at the temperature used, or solubility of C in Fe; K is a constant characteristic of the Fe and of the temperature. The rate of graphitization can be expressed by $\log \theta_e = mT + b$, where θ_e is the time in hrs. to reach equilibrium, "m" the slope of the line (which is the same for all Fe's), T temperature in °F., and "b" a constant characteristic of the Fe. Under otherwise equal conditions the rate of graphitization increases logarithmically with increasing Si content. Si favors formation of graphite nuclei and raises the Ar_1 point; increasing Si decreases the solubility of C in austenite. In order to make an Fe which will anneal rapidly no elements, such as Cr, may be added which will stabilize the carbide or can form films or obstructions at the grain boundaries to hinder the diffusion of C atoms. Superheating the molten Fe's increases rate of graphitization by favoring formation of more graphite nuclei upon annealing. Accelerated cooling in the molds of the Fe has the same effect. Physical properties of superheated and non-superheated Fe's are practically the same, but high soaking temperatures show slightly lower physical properties than lower temperatures. Controlled atmosphere permits the elimination of scaling, decarburization and pearlite rims, but has little influence upon graphitization rate. The silicon range should be from 1.5-2.0%. 34 references. Ha (5d)

The Malleablizing Process for Black and White Cast Iron (Beitrag zur Kenntnis des Temperprocesses auf Schwarz-und Weissguss) H. SPRINGKAEMPER. *Die Giesserei,* Vol. 20, Dec. 8, 1933, pages 541-548. Influence of annealing and cooling on structure was investigated. High C malleable castings must be malleableized longer than those with low C on account of the greater content of eutectic FeC. The annealing temperature must be maintained only until the equilibrium according to the Fe-C diagram has been reached. For longer duration the crystal grain in both kinds of malleable Fe becomes coarser and oxidation sets in in white castings. Sudden temperature drop and malleableizing further at the lower temperature favors fine structure. Insufficient malleableizing and overheating causes brittleness. White castings must be brought not too fast to the malleableizing temperature in order to obtain a uniform mixture. Ha (5d)

Effect of Superheat on Annealing of Malleable Iron. A. E. WHITE & R. SCHNEIDEWIND. *Iron & Steel Industry & British Foundryman,* Vol. 6, Aug. 1933, pages 371-375; *Transactions American Foundrymen's Association,* Vol. 41, 1933, pages 98-111. Three groups of irons were investigated, the first of standard foundry composition, the second and third of electric furnace iron low in C and Si. Superheat temperatures ranged up to 2970° F. for the foundry Fe and up to 3180° F. for the electric furnace irons. Superheating was capable of reducing normal malleableizing cycles up to 50%. CHL (5d)

Carburizing (5e)

Carburizing with Butane Gas. C. W. SPICER. *Transactions American Society of Mechanical Engineers,* Vol. 55, June 15, 1933, pages 31-36. The advantages of carburizing with butane (C_4H_{10}) over other hydrocarbon gases of the paraffin series are summarized as follows: smaller temperature range than commercial solid carburizers; carburizing material at low cost; maximum carburizing rate at metallurgically and economically advantageous temperatures; no admixture of air or other gases required; no labor or space required within the plant for handling or storage of solid carburizer; carburizing process so free from dust and dirt that with proper furnace equipment it may be placed in the regular line of manufacture; absolute control of depth and character of case. The mechanics of carburization are discussed in general; butane is commercially obtained as a by-product from petroleum cracking. It requires only 815°F. for breaking up in the presence of steel while methane requires 1200°, propane 860°, ethane 840°. Carburizing tests made between 1450 and 1700°F. showed a range of 1575° to 1625° to be the most satisfactory. At higher temperatures the grain structure became less satisfactory and the process less economical. Under proper conditions the penetration of C is as rapid as by any other commercial process and a properly graduated case can easily be obtained. The surface may be hypereutectoid, eutectoid or hypoeutectoid. Ha (5e)

Case Hardening and Shorterizing: A Comparison. A. E. SHORTER. *Mechanical World & Engineering Record,* Vol. 93, Sept. 29, 1933, page 935. The "Shorter" process is dependent upon the material containing sufficient combined C and other hardening elements. Case-hardening is only suitable for low carbon steels, whilst the "Shorter" process is applicable to the medium and high C steels as well as hardenable alloy steels, shorterizing is suitable for hardening cast iron, white heart malleable (after machining) cast iron, and semi steel. Iron and steel castings which are not case hardened on account of costs can be entirely or locally hardened by the "Shorter" process. A table presents a comparison between the case-hardening "box" method and the "Shorter" process, showing the limitations to the use of both methods and for this reason one is complementary to the other to some degree. Lower costs of the "Shorter" process are pointed out. Kz (5e)

Hardening and Case Hardening of Steel Parts in Fused Salts. MARTIN STROMEYER. *Iron & Steel Industry & British Foundryman,* Vol. 6, Aug. 1933, pages 389-390. The essential requirements of the process, the period of heat treatment, the compositions of carburizing mixtures and the limitations of the fused salt methods for hardening steel are discussed. Decarburized surfaces of steel parts can be recarburized by placing the pieces for a few minutes in fused cyanide salt mixtures. CHL (5e)

Gas Carburizing Process Is Widely Adopted in 1932. *Steel,* Vol. 92, Jan. 2, 1933, pages 92-93. Review of developments in 1932 in heat-treating processes and equipment. MS (5e)

"Chapmanizing": A Process for Hardening Low Carbon Steel. *Modern Machine Shop,* Vol. 6, Aug. 1933, page 26. The process, description of which is not given, is said to give a Brinell hardness of 700 to 900, in some cases 1100, to low C steels to a depth of 0.25". The treatment requires 48 hrs. Ha (5e)

Nitriding (5f)

New Ways of Hardening Steel. (Neue Wege der Stahlhärtung.) OTTO GASSNER. *Automobiltechnische Zeitschrift,* Vol. 35, Nov. 25, 1932, pages 552-553. See *Metals & Alloys,* Vol. 4, May 1933, page MA 148. Ha (5f)

Theory and Practice of Nitrogen Case-Hardening. (Theorie und Praxis der Stickstoffhärtung.) A. FRY. *Die Metallbörse,* Vol. 22, 1932, page 931. See *Metals & Alloys,* Vol. 4, Jan. 1933, page MA 10. EF (5f)

The Role of Nickel in Nitriding Steels. H. J. FRENCH & V. O. HOMERBERG. *Iron Age,* Vol. 130, Oct. 6, 1932, pages 534-535, adv. page 16. See *Metals & Alloys,* Vol. 4, Oct. 1933, page MA 321. VSP (5f)

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FURNACES, REFRACTORIES & FUELS (6)

RICHARD RIMBACH, SECTION EDITOR

Ferro-coke and Its Metallurgical Features. A. N. Pokhvistnev, P. P. Demchuk, B. A. Spevakov, S. M. Meerov & I. F. Ulianov. *Domez,* No. 4, 1933, pages 14-29. (In Russian) To the standard coking charge different amounts of ore were added. The mixture was placed in a steel box on the bottom of coke oven which was filled with coal and coked as usual. Laboratory investigation of coke so produced showed that its burning capacity is improved while gas penetrability is raised considerably. S loss of 44.6% in usual coking is reduced to 33.0% with 20% ore addition. Mechanical properties remain satisfactory with 20% ore addition, but fall down with higher ore content. Up to 67% of Fe in ore addition is reduced to metal after coking. A study of the resistance of refractories to the action of coke ash containing large percentages of Fe showed that silica brick has a much greater resistance than fire brick. (6)

Some Factors Leading to a Greater Production from a Steel Furnace. Arthur Robinson. *Iron & Steel Institute,* Advance Copy No. 13, Sept. 1933, 11 pages; *Foundry Trade Journal,* Vol. 49, Sept. 28, 1933, pages 175-176; *Iron & Coal Trades Review,* Vol. 127, Sept. 15, 1933, pages 382-383; Nov. 3, 1933, pages 667-668. Gives some recommendations for economical operation of open-hearth furnaces based on observations of a tilting furnace. Checkers with wedge brick have been found to be satisfactory. The roof of a furnace was insulated near the ends; it dripped and rapidly melted away. Bottom insulation, 2 in. of magnesia-asbestos brick under the magnesite brick, was satisfactory. Automatic control of the air-gas supply with specially constructed equipment worked well. Recording pyrometers should be used to indicate checker temperatures. Proper charging of scrap is important. A carbometer is used for rapid C analysis; it takes only 2½ min. to take sample and make analysis. It is recommended that technically educated men be trained as melters; the pay and prospects are good. OWE + Ha + JLG (6)

Practical Methods for Heating Solids by Induction. E. F. Northrup. *Iron Age,* Vol. 131, Jan. 26, 1933, page 165, adv. sec. page 14; Feb. 23, 1933, pages 310-311, adv. sec. page 10; *Steel,* Vol. 92, Mar. 6, 1933, pages 21-24; Mar. 20, 1933, pages 23-26. Abstract of paper read before the Pittsburgh district section of the Association of Iron and Steel Electrical Engineers, Jan. 14. An important consideration in using inductive heating is whether the product is magnetic or non-magnetic. The process is intended for use in annealing, normalizing or forging; it is an extension of principles applied in the development of high-frequency induction furnaces for melting metals. Concluding installment describes the use of electric inductive heating in the manufacture of razor blade steel and Cr plated tubes. Envisions wide application of inductive heating in the future. Cites advantages of method. MS + VSP (6)

Ideal Fuel Consumption in the Production of Steel. K. R. Binks. *Iron & Steel Industry & British Foundryman,* Vol. 6, Mar. 1933, pages 211-213. Discussion of influence of certain factors on surplus gases available in steelworks of the ''balanced'' type. The sum total of coal charged to the coke ovens and supplementary coal used in mill is defined as the ideal overall fuel consumption per ton of finished steel. Data are compiled to show surplus and deficiency of B.T.U's according to steel melting process, normal yield and percentage of scrap used per ton finished steel, and the ideal overall fuel consumption per ton finished steel from coke ovens to steel mills. Scrap usage favorably influences the amount of surplus gas available but unfavorably influences the overall fuel consumption. CHL (6)

Electric Purification of Blast Furnace Gases (De l'épuration électrique du gaz de haut-fourneau) M. Richarme. *Revue de Métallurgie,* Vol. 30, Sept. 1933, pages 402-418; Oct. 1933, pages 423-452; Nov. 1933, pages 471-477. Amount of dust carried by the blast can be reduced by making the diameter of the top equal to that of the hearth, but quality of ore can make this measure useless. Principles of electric precipitation are summarized. High voltage transformers of Spig and Westinghouse Company are described. Schemes of Cottrell-Spig, Cottrell-Lurgi and Siemens-Schuckertwerke are given. Combination of Cottrell principle is advantageous when based on old data. The advantages connected with saving of sensible heat obtained in electrostatic purification of hot gases are greatly overbalanced by losses due to high H_2O content, increased size of apparatus and by back ionization. Installation using hot purification of American Manganese Manufacturing Co., Colorado Fuel and Iron Co., Mingo Works of Carnegie Steel Co. and at the plants in Skinningrove, Ulverston, Workington in England are described giving the results obtained in them. The last 3 are of Lodge-Cottrell type. Hot cleaning produces gas with 0.2-0.6 g./m.^{3} of dust. For cleaning to 0.10-0.30 g./m.^{3} in one stage the gas must be cooled by water spray to below 100° C. About 0.15 m.^{3} of water is used for every 1000 m.^{3} so treated. Relative humidity is very important. It should be as high as possible without reaching dew point in the precipitators, 0.58% can be considered as the best. Before precipitation gases should be cooled and humidified to the proper extent by means of a cooler, humidifier and a heater. Several systems of electrostatic cleaning equipment are available. In Cottrell apparatus gases circulate upwards in cylindrical pipes which are provided with rapping arrangement for precipitation of deposited dust and a device for stopping automatically both gas and current at this time. Apparatus of Elektrische Gasreinigung Gessellschaft (Elga) has vertical pipes and a device for stopping automatically gas and current during rapping which is done by hand. Dust is blown down here with a stream of clean gas. Siemens Schuckertwerke installation consists of rectangular channels of very much larger cross section than pipes of the former types. Gases travel in it downwards and then upwards. Rapping devices act at intervals and without interfering either with gas or with current. Elga gas purifiers are installed at blast furnaces of Witkowitz, Hokingen, Homecourt, Hussigny and Mont-Saint Martin. Detailed description of installations and operating practice at Witkowitz, Dilling, Huckingen and Homecourt is given. Siemens Schuckertwerke installed purification plants at Rheinische Stahlwerke' plants located in Dortmund, Oberscheld, Falvahuette, Georgmarienhuette and Krupp's at Borbeck. They are fully described. Lurgi Society offers an apparatus which produces gas with less than 0.005 g./m.^{3}. It consists of two units placed after dustcatchers. Each of them contains a cooler and a humidifier which are combined and an electric precipitator. A tower without baffles with air spray provided at the top of it is used as cooler in the first unit. The second has a similar tower but with baffles. The first precipitator is of horizontal type having corrugated sheet electrodes, and bar cathodes. The former are rapped at short intervals without interrupting either current or gas. Dust is continuously removed from the bottom. The second precipitator is of the same type, but is shorter and has flat anodes. Dust and moisture are precipitated here as mud which is flushed off twice a day. Five commercial installations are in use, one at the newest blast furnace plant at Pretoria. Luebeck installation with the capacity of 40000-50000 m.^{3} per day is described in full. Operating costs for these methods compare favorably with the costs of wet purification with disintegrators. JDG (6)

Electric Furnace Retired After Fifteen Years of Continuous Service. *Foundry,* Vol. 61, Apr. 1933, page 20. Describes the world's first electric furnace of the Moore type, which after 15 years is being erected as a permanent monument at Lakeside power plant of Milwaukee Electric Railway & Light Co. VSP (6)

Nomogram for Rapid Computation of Induction Furnace with Magnetic core (Abaque pour le Calcul Rapide des Fours à Induction à Noyau Magnétique) *La Technique Moderne,* Vol. 24, Nov. 1, 1932, page 699. Abstract of 2 studies, one of A. Levasseur and one of M. Mathieu. RF (6)

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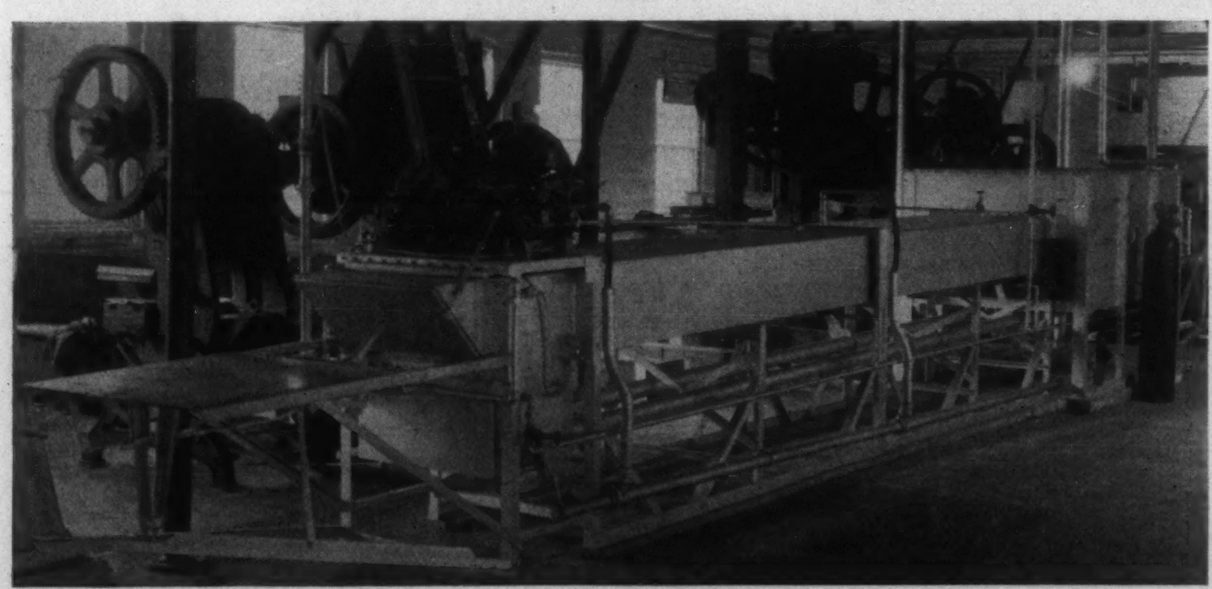

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Furnace Atmospheres and Steel. CLAIR UPTHEGROVE. *American Gas Association Monthly*, Vol. 15, May 1933, pages 181-184. **Scaling of Steels at Heat Treating Temperatures.** *Engineering Research Bulletin, University of Michigan*, No. 25, Aug. 1933, pages 1-34. Work done at the University of Michigan on the effects of atmospheres on steel.

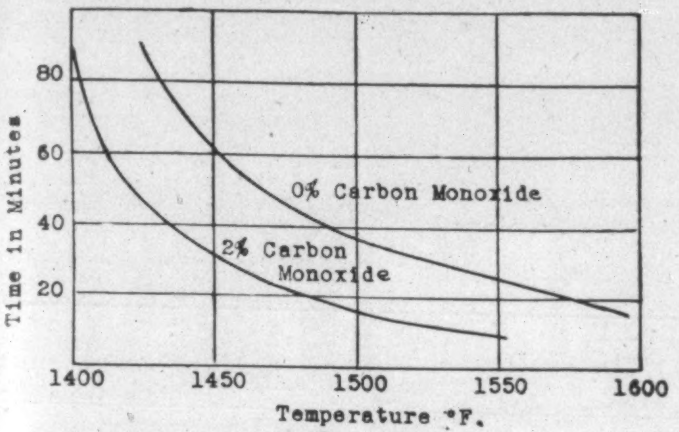
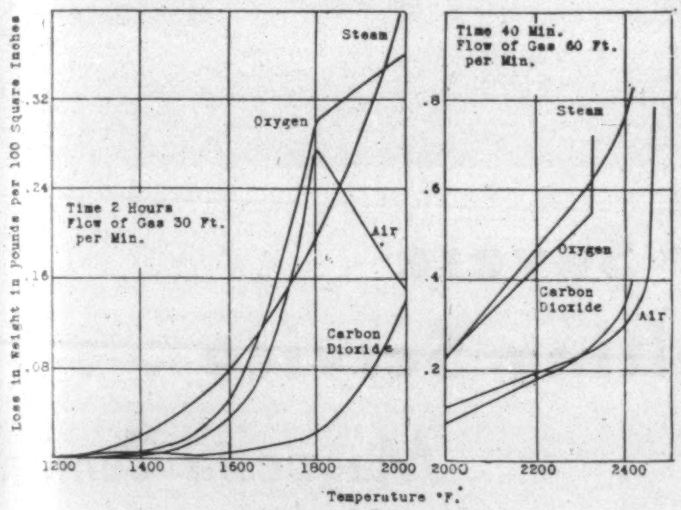
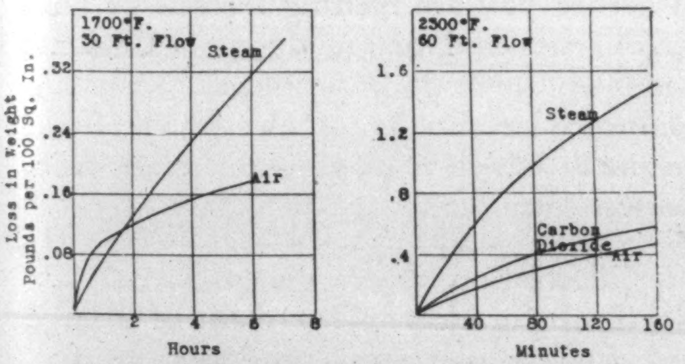


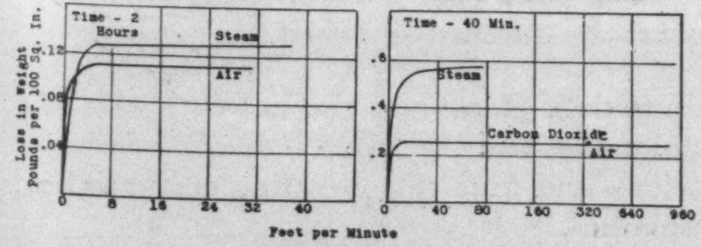
FIG. I
LIMITING TEMPS. & TIMES TO AVOID DECARBURIZING 0.85% C STEEL



FIGS. 2 & 3
EFFECT OF TEMP. ON SCALING OF LOW C STEEL



FIGS. 4 & 5
EFFECT OF VARIATION OF TIME ON SCALING OF LOW C STEEL



FIGS. 6 & 7
EFFECT OF VARIATION OF GAS FLOW ON SCALING LOW C STEEL

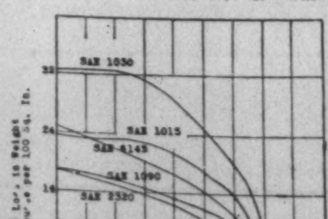


FIG. 8. SCALING OF C & ALLOY STEELS IN 40 MINS. IN VARIOUS FURNACE ATMOSPHERES AT 2300°F.

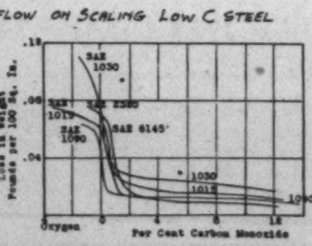


FIG. 9. SCALING OF C & ALLOY STEELS IN 60 MINS. IN VARIOUS FURNACE ATMOSPHERES AT 1700°F.

Ha + RJCp (6)

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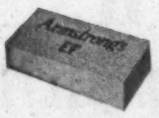

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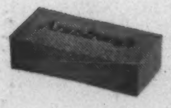

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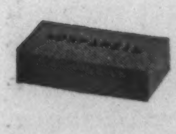

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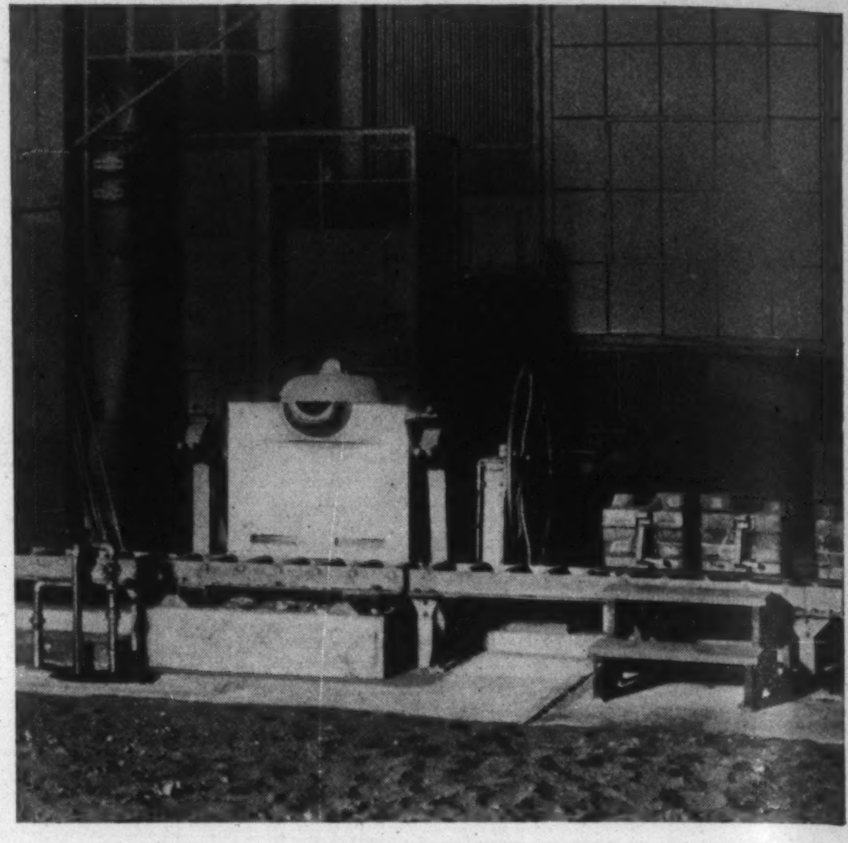

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The Construction of Cupola Furnaces in Europe. Ratio of Furnace Elements. M. Steyer. *Iron & Steel Industry & British Foundryman*, Vol. 6, Mar. 1933, pages 203-204, 213. Construction of modern American and European cupolas exhibit a number of striking basic differences, especially as regards the ratio of furnace elements. The differences in height of cupola, the ratio of its diameter to height, location, size and form of tuyeres and ratio of tuyere area to furnace area in the 2 continents, as given in article, appear certain that these elements are not governed by definite theoretical reasoning. CHL (6)

Electric Furnace in the Steel Foundry (Der Elektroöfen in der Stahlgeisserei) W. Behling. *Elektrowärme*, Vol. 3, Oct. 1933, pages 312-316. Operation and results of a 3-phase furnace of 4 tons with charges up to 8000 kg. for making steel exclusively from scrap are described. Graphite electrodes of 230 mm. are used. Construction details and tables of cost production under different conditions are given. Ha (6)

Investigations of the Heat Exchange in Pusher Furnaces (Untersuchungen über den Wärmeaustausch in Stossöfen) H. Stoffregen. *Archiv für Eisenhüttenwesen*, Vol. 6, Jan. 1933, pages 271-276. Tests in the Peiner Walzwerk have shown that a pusher furnace can be very well considered, section by section, as a radiating black body in spite of the gas flow which is hotter than the walls. Only if a body in the furnace is heated to considerably higher temperature than walls or ingots need the heat emission be taken into account. The heat transmission is greatest in the center of the furnace and decreases from there both in the vertical and horizontal direction. Greatest difference in heat exchange measured in this particular case (length of furnace 21 m.) was 24% of the lowest value. The greatest temperature differences measured were 300° C. or 37% of the lowest ingot temperature. Full description of tests. Ha (6)

Development of Metallurgical High-Frequency Furnaces (Entwicklung der metallurgischen Hochfrequenzöfen) Manuel Tama. *Zeitschrift Verein deutscher Ingenieure*, Vol. 77, Feb. 25, 1933, pages 199-202. Recent development of high-frequency furnaces in steel production is reviewed. This modern type is said in its present state to be superior to the electric-arc furnace with regard to operating cost even in small units. The larger the furnace the lower can be the frequency, usually now between 600 and 1000 per sec. This is mainly a question of energy consumption and cost of energy. Several European and American installations are described. Ha (6)

Surface Combustion (De la combustion superficielle dans les fours à grand volume de laboratoire) J. Brodin. *Aciers Spéciaux, Métaux et Alliages*, Vol. 8, Oct. 1933, pages 223-231. A new surface combustion furnace "Turbillon" is used in France for reheating large ingots before rolling. Ingots up to 100 tons size may be heated in this type furnace in which coke oven gas is used as fuel. It takes about 32 hours to heat a 100-ton ingot and requires 34,900 cu. ft., coke oven gas. The desired temperature may be controlled within 10° C. GTM (6)

Progress in the Construction of Gas-Heated Industrial Furnaces (Fortschritte im Bau gasbeheizter Industrieöfen) Otto Wolff. *Zeitschrift Verein deutscher Ingenieure*, Vol. 77, Dec. 2, 1933, pages 1273-1276. The latest progress in modern gas furnaces is mainly in the direction of utilization of waste heat by metallic heat-exchangers; the efficiency is almost the same as that of electric furnaces. Due to high price of electricity the gas furnace is often still more economical. Temperature control and heat distribution approach electric furnaces. Examples of pusher type and continuous furnaces, gas burners, mixer arrangements are illustrated and operating data given. Ha (6)

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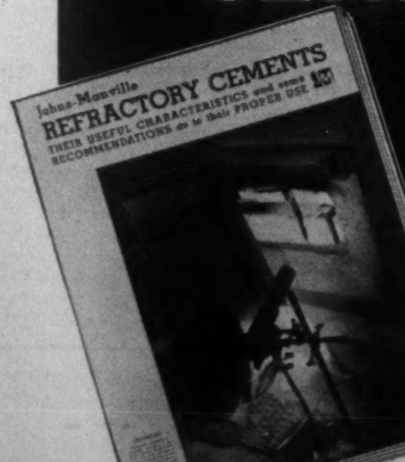
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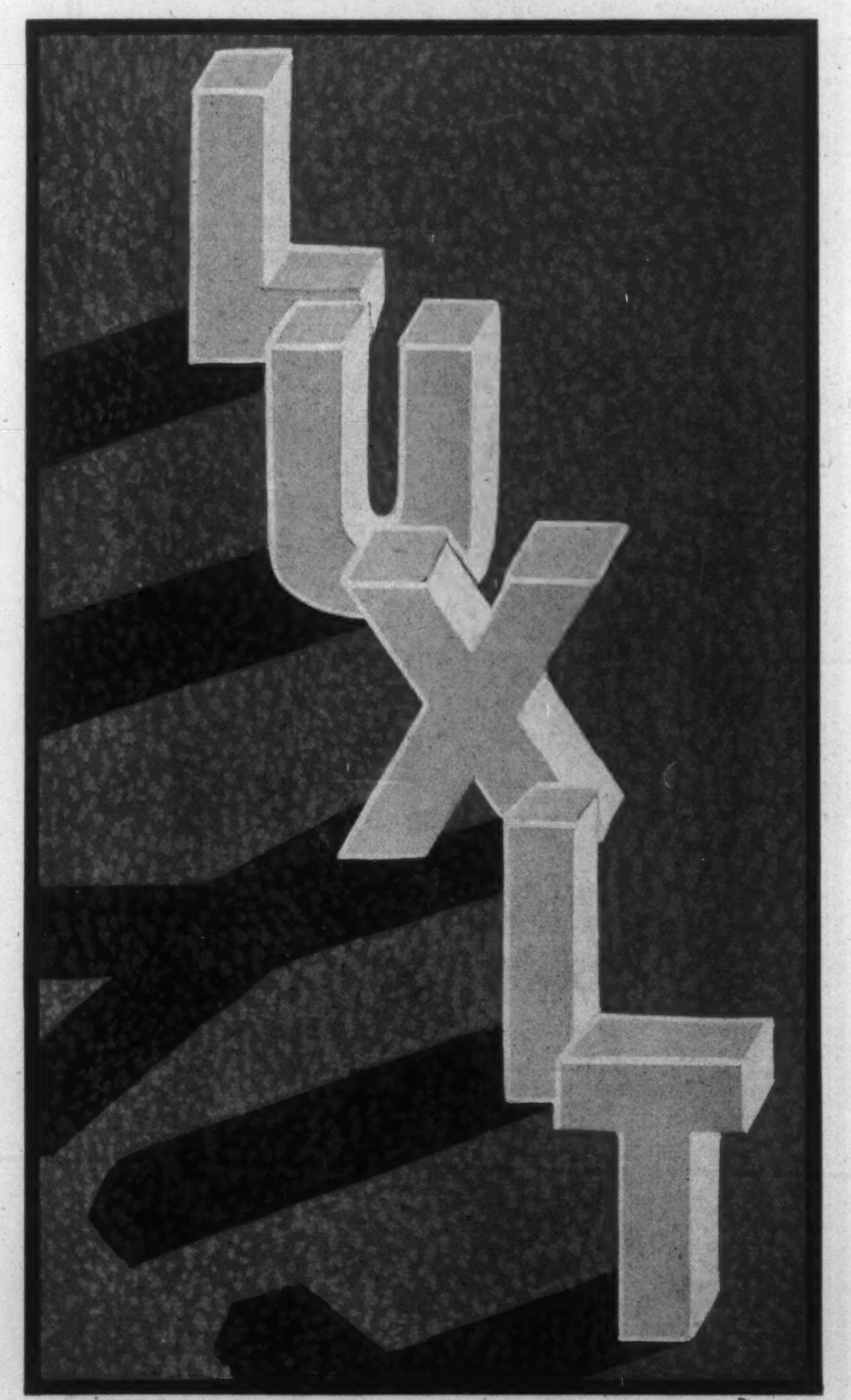

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Oil Fuel for Industrial Furnaces. The Importance of Proper Combustion. F. JOHNSTONE TAYLOR. *Metal Industry*, London, Vol. 43, Dec. 8, 1933, pages 555-557. Oil as fuel for furnaces in countries like England where oil is expensive is discussed and found advantageous particularly in small installations and when the heating process is intermittent and fast heating is necessary. High and low pressure burners and the comparative installation costs, performance, rotary furnaces for ferrous and non-ferrous metals are discussed and a few installations briefly described. Ha (6)

Modern Industrial Resistance Furnaces (Neuzeitliche Widerstandsöfen in der Industrie.) E. SCHMIDT. *AEG-Mitteilungen*, July 1933, pages 116-122. Describes batch and continuous furnaces for heat-treatment, heating of metal baths, etc. Advantages are seen in the convenience of accommodation at any desired place in the manufacturing line. Ha (6)

A Coke-fired Reheating Furnace. F. LLOYD & R. V. WHEELER. *Iron & Steel Institute*, Advance Copy No. 10, Sept. 1933, 11 pages; *Iron & Coal Trades Review*, Vol. 126, Sept. 15, 1933, pages 383-385; *Fuels & Furnaces*, Vol. 11, Sept./Oct. 1933, pages 183-185. In order to have a furnace whose bed would stay hot during charging a bed of broken fire brick was used in combination with gas heating. The fire brick was then replaced by coke with satisfactory results. Little scaling or decarburization resulted from heating alloy steels in the furnace. In another furnace the bed of coke was used as the sole fuel after the furnace had been brought up to temperature. The coke was first heated with an air-gas mixture and the gas then shut off. This furnace was satisfactory for heating high-speed and other alloy steels for quenching. Ha + JLG (6)

Electric Melting Furnaces with Basket Charging and Rotating Furnace Chamber (Elektroschmelzöfen mit Korbbeschickung und drehbarem Ofengefäss) OSKAR NEY. *Zeitschrift Verein deutscher Ingenieure*, Vol. 77, July 1, 1933, pages 695-696. **New Features in the Construction of Electric Melting Furnaces (Nouveautés dans la construction des fours électriques de fusion)** *Journal du Four Electrique*, Vol. 42, Dec. 1933, pages 437-439. General description of installations using basket charging of electric arc furnaces to protect the furnace lining from mechanical damage when charging. JDG + Ha (6)

Classification of Industrial Furnaces (Klassifikation der Industrieöfen) I. M. RAFALOWITSCH. *Feuerfest-Ofenbau*, Vol. 9, July/Aug. 1933, pages 99-105. The shortcomings of previous attempts at classification according to Grum-Grzimajlo, Salesskij, Hermansen, Trenkler, Appel & Damour, Trinks, Maurer are critically discussed and the author's new system of classification is introduced. EF (6)

Heat Losses of Industrial Electric Furnaces (Ueber die Wärmeverluste Elektrischer Industrieöfen) V. PASCHKIS. *Elektrotechnik und Maschinenbau*, Vol. 51, June 25, 1933, pages 368-370. The heat losses by storage and through walls and openings are analyzed and it is explained how the thickness of each layer of a composite wall must be determined for a minimum of heat losses. Ha (6)

Electric Heat in the Production of Steel, Introduction and Development of Electric-Steel Production (Elektrowärme als Wärmequelle bei der Stahlerzeugung, Einführung und Entwicklung der Elektrostahlfabrikation) TH. PAWELCZYK. *Elektrowärme*, Vol. 3, Aug. 1933, pages 267-271. Development of electric heating methods for steel production is discussed and it is shown how their application has led to a mass production of good quality. The use of electric heating has made possible the production of an almost chemically pure Fe of Thomas steel, free of O_2 or O_2 compounds; this question of deoxidizing which in former years gave so much difficulty can be considered as satisfactorily solved. Ha (6)

Increasing Use of Electric Furnaces in Russia (Le developpement des emplois du four électrique en Russie) *Journal du Four Electrique*, Vol. 42, Oct. 1933, pages 351-354. Comments on paper by C. H. Vom Baur *The Electric Furnace and its Production in the U.S.S.R.* at the Montreal Meeting of American Electrochemical Society. When everything planned is completed, Vom Baur's figures will not present the actual situation. JDG (6)

Review of Recent German Patents on Electrodes and Electric Furnaces (Revue des récents brevets allemands concernant les électodes et les fours électriques) *Journal du Four Electrique*, Vol. 42, Dec. 1933, pages 442-443. A reprint from *Zeitschrift fuer Elektrochemie und angewandte physikalische Chemie*, Oct. 1933. JDG (6)

Design of Checkers in Blast Furnace Stoves. (Ueber den Entwurf des Gitterwerks von Hochofenwinderhitzern) K. RUMMEL. *Archiv für das Eisenhüttenwesen*, Vol. 7, Sept. 1933, pages 175-185. From practical experience with blast furnace stoves the best conditions for medium blast temperatures in respect to reversal time, amount of heating gas, strength of the brick, area of base, height, length of channel, rate of flow, and roughness of the brick, are considered. The data are presented in 16 figures and 1 large table. 14 references. SE (6)

Induction Furnaces for Superheating of Cast Iron (Induktionsöfen zum Ueberhitzen von Gusseisen) E. FR. RUSS. *Elektrowärme*, Vol. 3, Mar. 1933, pages 55-56. Operating results of an induction melting furnace of 600-1000 kg. capacity with 2 melting grooves are given. Fe is supplied to the furnace at 1200° C. and heated up to 1550° to 1600° C. in 25 to 30 minutes; during this time additions of Fe-Cr, Fe-Si or Fe-Mn are made according to requirements. Consumption is 60-70 kwh./ton, the idling period requires 20 kw. During an 8-hour shift 15 melts can be made, the cost is RM. 4.25/ton. The cast Fe turned out is of a very high grade commanding a higher price than ordinary cast Fe. Ha (6)

Induction Furnaces (Induktionsöfen) E. FR. RUSS. *Elektrowärme*, Vol. 3, Aug. 1933, pages 256-257. The advantages of modern induction furnaces for melting and refining of ferrous and non-ferrous metals and alloys are discussed. A few types for 100-3000 kg. capacity and their particular construction details described and some operating data given. The economy of this type of furnace for small brass and other non-ferrous metal foundries is pointed out. Ha (6)

Electric Furnaces for Melting Aluminum (Elektrische Oefen zum Schmelzen von Aluminium) E. FR. RUSS. *Aluminium*, Vol. 15, Apr. 15, 1933, pages 3-5. Constructive details of induction melting furnaces for 10-40 kg. Al/hr. or 16-75 kg. Zn/hr; energy consumption 0.44 kw.hr./kg. for Al and 0.14 kw.hr./kg. for Zn. Ha (6)

Preparation of Slag Resistant Crucibles for Coreless Induction Furnaces (Die Herstellung schlackenbeständiger Tiegel für den kernlosen Induktionsofen) H. SEIGEL. *Archiv für das Eisenhüttenwesen*, Vol. 7, July 1933, pages 21-23. Very detailed directions for preparing induction furnace crucibles to withstand slag attack. SE (6)

Hot Blast Stoves in German Blast Furnaces (Winderhitzer auf deutschen Hochofenwerken) H. SCHMITZ. *Stahl und Eisen*, Vol. 53, Aug. 10, 1933, pages 821-831, 856-861. Summary of present German practice in building and operation of hot-blast stoves for blast-furnaces. 32 references. SE (6)

Modern Arc Furnaces (Die neuzeitlichen Lichtbogenöfen) W. BERNDT. *Die Metallbörse*, Vol. 23, July 1, 1933, pages 829-830. History, utilization, advantageous heat and temperature control, absence of contaminations are discussed. Arc furnaces of 10-30 ton are preferably employed in Europe for making of steel for roller bearing balls, dynamo sheets and special steels: Cr. Ni. W. and V. Recent advances stressed are: shortening of melting time by one half, i.e. to 1.5-2 hrs. per charge, improved insulation of the hearth, increase of specific load from 150 kw/ton to 500 kw/ton. The basic method prevails in continental plants due to higher S and P contents of the less pure raw materials. Service data on 4 ton electric furnaces are presented. Desulphurization down to 0.01% is accomplished and low oxygen contents of the steel are ascertained. The electrical data on a 3 and 30 ton furnace are given. Economy of larger units is pointed out. EF (6)

Some Problems of Furnace Heating Practice. ROB. A. HADFIELD & R. J. SARJANT. *Iron & Coal Trades Review*, Vol. 127, Sept. 29, 1933, pages 475-476; Oct. 6, 1933, page 513. Recent developments in design and operation of heating furnaces, flow of gases, utilization of radiation, control instruments, etc. are discussed and future investigations pointed out which may lead to further improvements. Ha (6)

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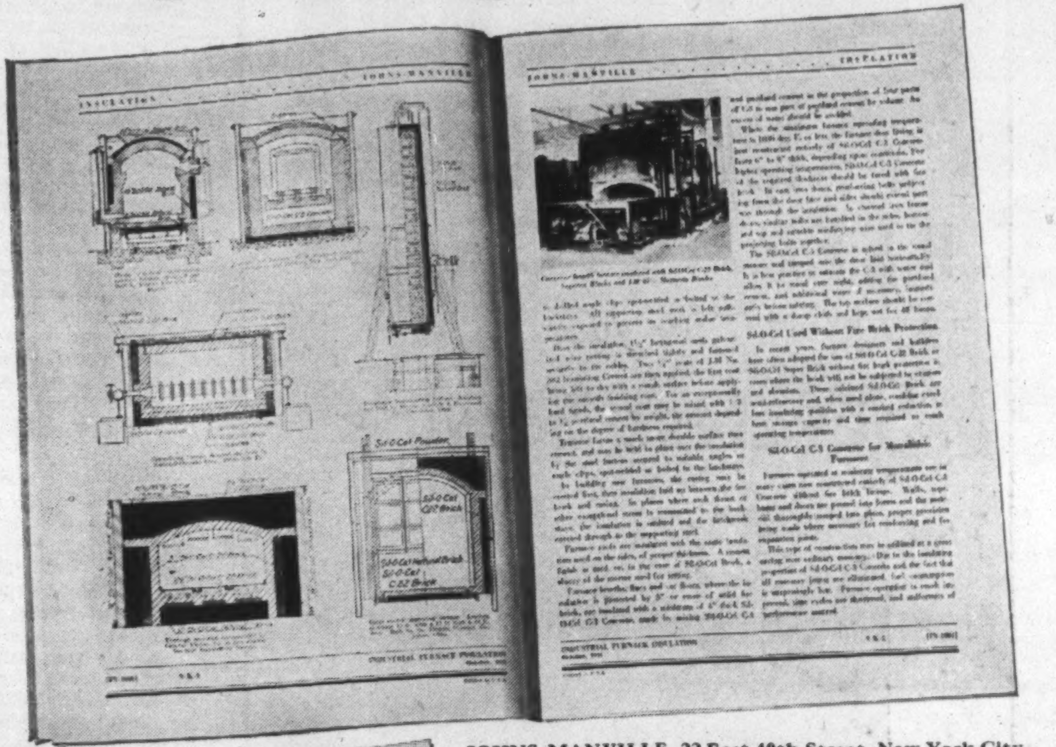

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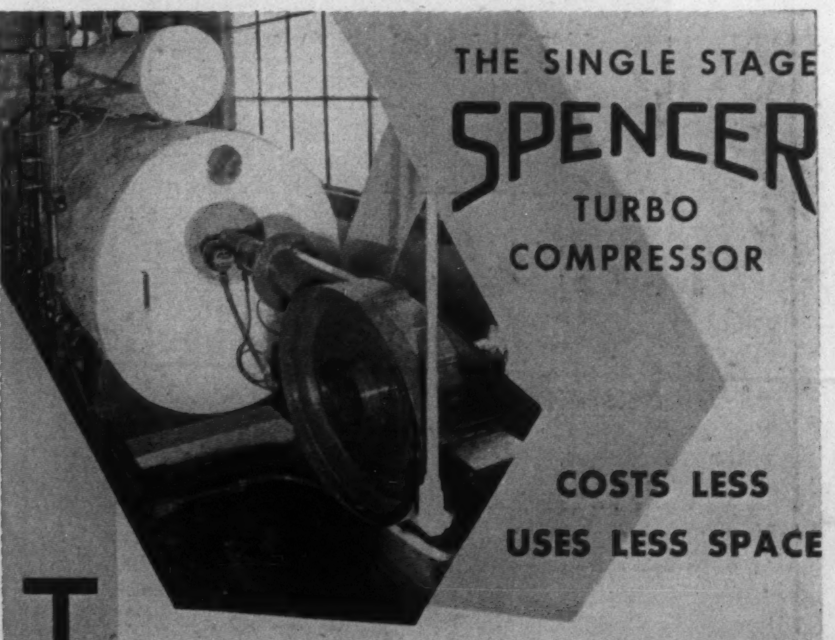

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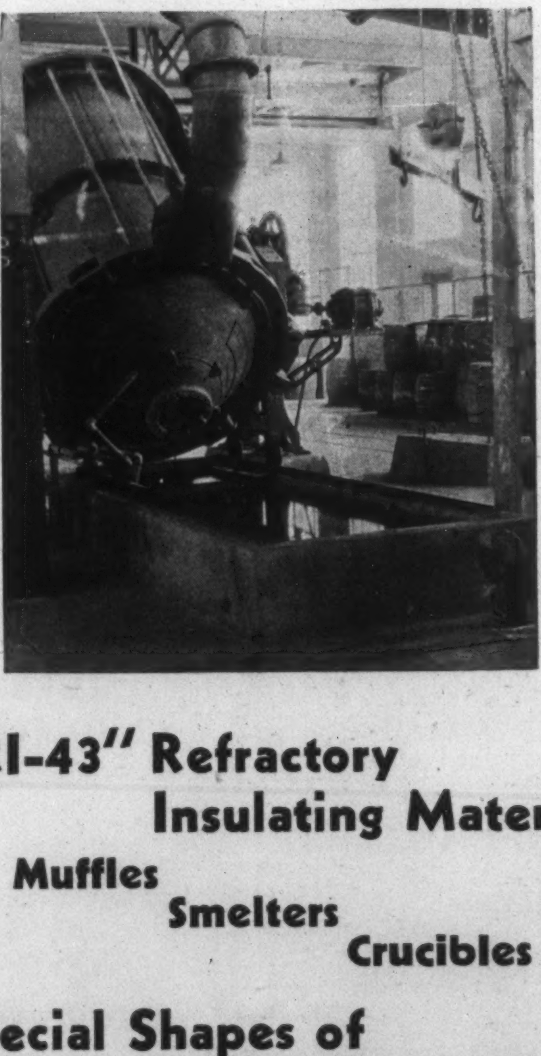

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Application of Electric Melting Furnaces in Foundries (Die Anwendung von Elektro-Schmelzöfen in Giessereibetrieben) L. SCHMID. *Zeitschrift für die gesamte Giessereipraxis,* Vol. 54, Nov. 12, 1933, pages 463-465; Nov. 26, 1933, pages 489-490; Dec. 10, 1933, pages 507-509; Dec. 24, 1933, pages 525-528. Of electric furnaces developed in the last decade especially 2 types are of practical importance for foundries, electric arc furnaces according to Heroult and high frequency induction furnaces according to Northrup. Development and principal types of arc furnaces are first considered. The first practical important arc furnace is the Stassano furnace having the disadvantage of an unsuitable arrangement of electrodes (almost horizontal). The disadvantages of this arrangement are eliminated in the Heroult furnace. Similar in principle but differing in details of construction is the Nathusius arc furnace which, however, offers the disadvantage of necessitating raising of the electrodes upon tilting the furnace. In metallurgical respect all arc furnaces are characterized by very high temperatures that make possible rapid and intensive reactions between metal bath and slag, thus attaining good deoxidation and desulphurization. Application field is outlined. Largest and most important field of application is for making high test pearlitic cast Fe that cannot be processed of a like high quality in cupola. With low scrap and current prices and sufficient use arc furnace is as economical as cupola. Arc furnaces are also advantageously used for processing alloy cast Fe, Si cast Fe for pieces of small wall thickness (normal cupola Fe is enriched in Si in arc furnace by adding ferrosilicon and superheating) and acidproof high Si cast Fe. Also in processing small cast steel pieces of thin wall thickness, melting in Heroult furnace is better and with cheap current also more economical than any other melting process. Induction furnaces discussed; Röchling-Rodenhauser, Frick, Ajax-Wyatt and Northrup. Advantages and disadvantages of all these types are considered at length. The first mentioned types are not applied in cast Fe foundries, main field of application of Ajax-Wyatt furnace is brass melting. High frequency induction furnaces are particularly dealt with. Its main field is making of high quality alloy steels. For melting brass and bronze this furnace is superior to any other type. GNp (6)

High-Frequency Furnaces and Their Services to Industry. G. R. WEBSTER. *Iron & Coal Trades Review,* Vol. 128, Jan. 5, 1934, page 17. Developments and improvements in construction, materials and performance during the last 10 years are briefly reviewed. Ha (6)

Large Electric Furnace Installation. *Electrical Review,* Vol. 113, Dec. 15, 1933, page 846. Describes furnaces installed in the Al works at Zwetmetsoloto, Russia. There are 21 with a total rating of 4,316 kw., most of them being of the continuous conveyor type. MS (6)

Large Furnace with a Hydrogen Atmosphere. *Electrical Review,* Vol. 113, Aug. 25, 1933, page 246. Beldwins, Ltd., has installed in the Swindon Works of its Midland Branch, a shaft-type electric furnace with H_2 atmosphere for annealing electrical steel sheets and stampings. Claimed to be first commercial installation in United Kingdom. Capacity is 10 tons of sheets per heat. Use CO_2 to sweep out air after charging. During heating and annealing, H_2 is continuously circulated through the furnace to a washing and drying plant. Adequate cooling control has been provided by means of a large H_2O-cooling coil in the cover. Dynamo-quality sheets have losses 15-20% lower than by former methods. Consumption of electricity varies from 300 to 450 kwh. per ton of sheets, while about 50 cu. ft. of CO_2 and 125 cu. ft. of H_2 per ton are required. MS (6)

Investigation of Working of Hot Stoves. N. V. RULLA. *Domez,* 1933, No. 5-6, pages 14-30; No. 7, pages 20-29. In Russian. Based on statistical data of one year's work of a hot stove, factors entering into operation of hot stoves were very thoroughly analyzed mathematically. Two-stove and three-stove systems were investigated both for natural and forced draft and for two types of checkers. (6)

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JOINING OF METALS & ALLOYS (7)

Permanence of Screw-Joints and Means for Their Improvement (Die Dauerhaltbarkeit von Schraubenverbindungen und Mittel zu ihrer Steigerung) A. Thum & H. Wiegand. *Zeitschrift Verein deutscher Ingenieure,* Vol. 77, Sept. 30, 1933, pages 1061-1063. The permanence of screw joints depends on the material, shape of screw, manufacturing method and the stresses in service. By recognizing the latter and proper arrangement of the flow of forces suitable material can be selected and favorable shape given to the screw. Ha (7)

Welding and Soldering of Malleable Iron (Schweissen und Löten von Temperguss) L. v. Roessler. *Forschungsarbeiten auf dem Gebiete des Schweissens und Schneidens mittels Sauerstoff und Azetylen,* Series 8, 1933, pages 35-37; *Autogene Metallbearbeitung,* Vol. 26, Apr. 1, 1933, pages 97-99. The great difference in melting temperature of malleable iron and welding wire makes welding of the former rather difficult; the welded Zn becomes very hard and brittle even with slow cooling. Brazing leaves the piece soft. Black malleable Fe is much more suitable for welding than white malleable Fe due to its greater uniformity in composition while in white Fe, especially in larger sections, higher C content and un-malleableized parts of the previous pig iron remain, which are much harder. By proper, very slow, cooling between 800° and 650° C. after welding the total C can be precipitated as malleableized flakes but hard martensitic Fe and cementite are always enclosed. Tests have shown that malleableized C begins to be dissolved at 950° for black and at 1065° C. for white malleable Fe. This temperature should therefore not be reached in soldering and the solder must be selected accordingly. Monel metal which is sometimes used, is not suitable as it melts at 1360° C. Ha (7)

Soldering, Brazing, and Welding of Stainless Steel. A. Eyles. *Mechanical World & Engineering Record,* Vol. 93, Mar. 31, 1933, pages 306-308. Mechanical and chemical cleanliness is essential in soldering stainless steels. Soft-soldering can readily be performed by using correct fluxes, solders and properly tinned soldering tools. When a flame is used for heating, it must be free from C. A good solder consists of 66% Sn and 34% Pb and melts at about 360°F. Zinc chloride is called a suitable soldering flux, as it acts upon the oxides. Details of soldering technique are given. In brazing solders the constituent metals should be commercially pure. Even small quantities of Sn form a hard and brittle alloy with Cu and an alloy of low m.p. with Pb. A good flux consists of 2/3 calcined borax and 1/3 boracic acid made into a thin paste. To prevent adherence of the brazing solder to other parts of the work a mixture of molasses and graphite should be painted on. Dip brazing is effective and economical, but proper temperature of the molten alloy is important. For Ag brazing a Ag alloy is recommended which flows freely at 1435°F. In oxyacetylene welding of stainless steels a perfectly neutral flame should be used. Fluxes can be used to advantage. Mixture of 45% borax and 55% boracic acid is recommended. Heat treatment after welding removes hardness, increases anti-corrosive properties, and prevents weld decay. Electric-resistance spot welding and electric butt welding are touched upon. Majority of stainless steels should be annealed after arc welding and scale and slag must be removed from the welded areas by pickling, grinding or sandblasting. Kz (7)

Soldering & Brazing (7a)

C. H. CHATFIELD, SECTION EDITOR

Brazing of Cast Iron (Gusseisenlötung) M. Reichner. *Die Wärme,* Vol. 56, July 8, 1933, page 445. Built-up work on a gear. Teeth are replaced by new ones inserted into a dove-tail groove. The joint is filled with bronze, brass or Monel metal melted under a flux of borax or boric acid. EF (7a)

"Molecular Soldering" and Its Applications ("Molekulares Löten" und seine Verwendungen) D. L. Talmud. *Kolloid Zeitschrift,* Vol. 64, Aug. 1933, pages 227-229. The introduction of an adsorbing layer between the border faces of 2 solid phases is called "molecular soldering" because the cohesion between the surfaces is greatly increased. Several examples are described in which powders of metallic and organic substances could be made to adhere very strongly to each other by using paraffin, glycerin, alcohol, amylalcohol, etc., as ingredients. Ha (7a)

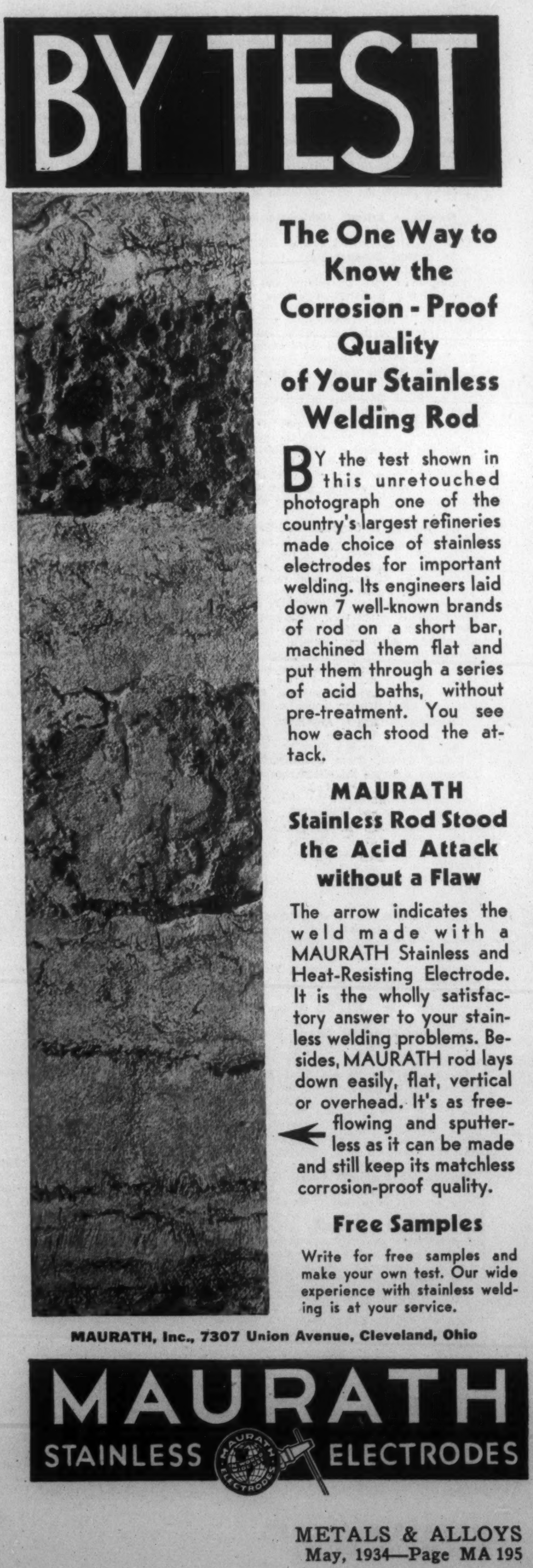
Aluminium Fluxes. *Metal Industry,* London, Vol. 42, May 5, 1933, page 478. In soldering Al fluxing with Zn chloride should be avoided as a small quantity of Zn is introduced into Al; for melting clean material cryolite or cryolite-containing mixtures should be used; these also develop much less smoke, are dry and can be kept in open containers but are not quite as effective as Zn chloride in cleansing dirty Al. Ha (7a)

Use of Silver Solder in Chemical Industry (Zur Verwendung von Silberschlagloten in der chemischen Industrie) Robert J. Snelling & Edmund Richard Thews. *Die Chemische Fabrik,* Vol. 6, Oct. 25, 1933, pages 443-445. Silver solders consist of either Ag-Cu-Zn alloys, with or without Cd or Ni additions, or of Ag-Cu, or Ag-Cd-Zn alloys. The composition, mechanical properties and melting point of a number of alloys is given. The most suitable composition depends on the metals to be joined. For brass which is to be worked after soldering the solder should contain 40-50% Ag and the balance Cu and Zn in a 3:2 ratio. The melting point varies with the Zn content. To lower it replace the Cu with Cd. Substituting Cd for Zn improves the mechanical properties. Sn is harmful in Ag solders. Fe and Pb make the solder brittle, but Ni increases the strength and hardness. Pure metals should be used in making solder. Borax, boric acid, or both, with or without the addition of $ZnCl_2$ or H_3PO_4, are used as flux. Acetylene or gas with air or O can be used for heating. Oxidizing flames should be avoided. High heat is required to solder Cu. The solders low in Zn have better corrosion resistance. Metals with melting point under 800° C. cannot be soldered to brass with Ag solder. Ag solder is used on nickel silver, monel metal, nickel, and stainless steel. The soldering heat affects the structure of some stainless steels. For stainless steel a solder low in Ag with 2-3% Ni is best. CEM (7a)

Welding & Cutting (7b)

C. A. McCUNE, SECTION EDITOR

Physical Properties of Gas-Fusion and Electric Arc Welds for Higher Strength Structural Steels. (Physikalische Eigenschaften von Gasschmelz-und Lichtbogenschweissen bei Baustählen höherer Festigkeit.) F. Sommer. *Autogene Metallbearbeitung,* Vol. 26, Jan. 15, 1933, pages 22-27. Tensile strength, shearing strength, bending angle and notch-toughness of welds on the German standard steels St 42, St 48, St 50, St 52 and St 60 were experimentally determined. Gas-fusion welding does not give the required standard values for shearing strength, but in general this method is permissible if an alloyed welding rod is used. Bare unalloyed electrodes are good for St 42 and 48. Coated electrodes give good results for all materials in all respects. The thinner the seam and the harder the material, the higher is the strength of the sample. St 60 offers some difficulties on account of its high C content which tends to formation of gas which requires the application of coated electrodes. The C content of structural steels should not exceed 0.35% and their alloying constituents should be of such kind as to make them less sensitive to the flame. All these points are discussed with reference to practical application. Ha (7b)



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Electric Welding of Cast Iron and Steel Castings and Its Economical Advantages (Die elektrische Kaltschweissung von Gusseisen und Stahlguss und ihre wirtschaftlichen Vorteile) E. Kalisch. *Elektrowärme,* Vol. 3, Nov. 1933, pages 333-335. Electric cold-welding (i.e. without preheating) has often proved to be perfectly feasible and satisfactory for cast iron pieces or steel castings provided the pieces were prepared properly. Small cracks or fissures need only be enlarged, larger ones should be made into a Vee by chiseling, entirely broken pieces should have an X-section at the weld. The electrode should be soft iron, and the electric arc is the most suitable means for welding. Several examples of repairs are illustrated. Ha (7b)

Welded Excavator for a Conveyor Crane (Geschweisster Greifer für eine Verlagebrücke) W. Krauss. *Forschungsarbeiten auf dem Gebiete des Schweissens und Schneidens mittels Sauerstoff und Azetylen,* Series 8, 1933, pages 54-56; *Autogene Metallbearbeitung,* Vol. 26, Oct. 1, 1933, pages 294-295. Detailed description of construction of welded excavator of 28 yd.^{3} capacity. Ha (7b)

Welding in Artcraft (Schweissen im Kunstgewerbe) J. Leemann. *Autogene Metallbearbeitung,* Vol. 26, Dec. 1, 1933, pages 360-362. Examples of decorative art in welded iron are illustrated. Ha (7b)

On Welding Stainless Steel. F. J. Giroux. *Industry & Welding,* Vol. 5, Apr. 1933, pages 14-15. Gives general instructions for gas welding, spot welding and electric arc welding, and for the latter currents and voltages to be used with different diameters of welding rods; the electrode must be positive, and a coated electrode should preferably be used to prevent the oxidation of Cr or Ni in the steel. If the stainless steel contains C between 0.07 and 0.20% the Straus heat treating method should be employed which consists in rapid heating from 2050° to 2150° F. and rapid cooling by water quenching on heavy sections and air cooling on light sections. Ha (7b)

Welding Quality Control in Aircraft Manufacture. P. N. Jansen & T. H. Speller. *American Machinist,* Vol. 77, Oct. 11, 1933, pages 651-655. The particular difficulties in welding met with in aircraft construction are pointed out. To assure better results the types of weld used in this work are classified and methods devised to check the work of older welders and to train new ones. Etchings are used to a great extent to discover defective welds. Ha (7b)

Welding Cast Steel vs. Rolled Steel. Chas. H. Jennings. *Electric Welding,* Vol. 3, Nov. 1933, pages 14-15. Experiments showed that cast steel can be successfully arc-welded to cast steel or hot-rolled low C steel by means of bare and fluxed electrodes; welding on cast surfaces is not appreciably harmful. 3/16″ electrodes with 180 amp. for bare and 190 amp. for fluxed electrodes were used. Ha (7b)

The Welding of Corrosion Resisting Steels. Chas. H. Jennings. *Welding Engineer,* Vol. 18, Oct. 1933, pages 15-16. Corrosion resisting steels are divided into 3 classes. Up to about 15% Cr they are susceptible to air-hardening and welds are hard and brittle so that they require heat-treating at 1200-1400° F. for restoration of ductility and toughness, except steels with less than 0.20% C which do not require any heat treatment. High C steels of this class are not well suited for welding. Steels with more than 15% Cr are not very susceptible to air-hardening and retain their corrosion-resisting properties at high temperatures, but they develop at high temperatures rapid grain growth which results in a hard and brittle joint which heat-treatment will not correct; also these steels are not recommended for welding. The 3rd group contains the austenitic Cr-Ni steels, in particular the 18-8 steel. This welds easily, without air-hardening and grain growth, and giving soft, ductile and strong welds with an ultimate strength of 65,000-75,000 lb./in.^{2} and yield point of 40000-50000 lb./in.^{2} Procedure to make good welds and precautions to prevent overheating are described. Ha (7b)

Resistance Welding of Aluminum. D. I. Bohn & G. O. Hoglund. *Welding Engineer,* Vol. 18, June 1933, pages 25-29. See *Metals & Alloys,* Vol. 4, Feb. 1933, page MA 40. Ha (7b)

Welded Control Cabin Understructure of Electrical Locomotives (Geschweisster Führerhaus-Unterbau bei elektrischen Lokomotiven) Helmholtz. *Organ für die Fortschritte des Eisenbahnwesens,* Vol. 88, Sept. 1, 1933, pages 334-336. Full structural details on the electric welded under-carriage of electric locomotives are given in text and illustrations. EF (7b)

Flame Machining. R. F. Helmkamp. *Welding Engineer,* Vol. 18, May 1933, pages 12-13. The use of the cutting blowpipe as a tool for gouging, de-seaming and other methods of shaping of metal is discussed and illustrated by examples. Ha (7b).

Welding from the Designer's Point of View. Charles O. Herb. *Machinery* (N. Y.), Vol. 39, May 1933, pages 569-571. Discussion of factors involved in designing various welded machines. RHP (7b)

Half a Million Inches of Welding a Week. Charles O. Herb. *Machinery* (N. Y.), Vol. 39, Mar. 1933, pages 433-436. Describes and illustrates the process of manufacture of domestic oil-burning units by the General Electric Co. Machines do 45% of the welding. RHP (7b)

Welding of a Lever of a Sheet Working Machine (Schweissen eines Hebels eines Blechverarbeitungsmaschine) F. Hermann. *Autogene Metallbearbeitung,* Vol. 26, Sept. 1, 1933, pages 266-267. A broken cast iron lever of 350 mm. length, 100 mm. width and 60 mm. thickness was cold-welded; procedure is described. Ha (7b)

Arc-Welded Floodlight Towers. J. P. H. Hively. *Welding Engineer,* Vol. 18, Oct. 1933, pages 20-21. Details of construction and welding procedure are described. Ha (7b)

Specifications for Welded Steel Constructions in Czecho-Slovakia (Vorschriften für geschweisste Stahlbauten in der Tschechoslowakei) Richard Hoffmann. *Die Elektroschweissung,* Vol. 4, Sept. 1933, page 171. Discussion of specification C S N 1120 for welded steel constructions. Whereas according to the German welding specification D I N 4100 choice of welding method is left to welding engineer Czecho-Slovakian specification merely permits electric arc welding on normal soft structural steels. In many other respects specifications are similar to German ones. GN (7b)

Welding the Aluminum Alloys. G. O. Hoglund. *Welding Engineer,* Vol. 18, Sept. 1933, pages 28-31. The welding method must be selected according to the physical properties of the alloys, and whether cast or wrought; a table of physical properties important for welding is given for the most used Al alloys. Oxy-hydrogen and oxy-acetylene is adaptable to torch welding; welding with carbon and metallic arc has been developed more recently; the latter is somewhat easier to handle in manual welding. Less distortion and higher speed can be obtained with arc welding. Spot-welding is used extensively especially for domestic utensils. The various processes are described fully and examples given. Ha (7b)

Welded Joints in Copper and Copper Alloy. I. T. Hook. *American Machinist,* Vol. 77, Nov. 8, 1933, pages 720-724. Brief discussion of difficulties of welding Cu and Cu alloys; practice is described to be followed and precautions to be observed in welding small tanks. Various types of welded Cu joints are illustrated. Ha (7b)

Shielded Arc Welding in Railroad Shops. W. B. Horton. *Welding Engineer,* Vol. 18, May 1933, pages 16-18; June 1933, pages 34-36. Describes many parts made and repaired in railroad shops and method of welding, types of electrodes with current to be applied with them and preparation of pieces for welding. Methods applied for ferrous and non-ferrous work are described. Ha (7b)

Cutting Steel Under Water. Charles Kandel. *Machinery* (N. Y.), Feb. 1933, Vol. 39, pages 369-373. Describes a steel cutting torch developed by Commander Edward Ellsberg during the winter of 1925. The torch is about the same size and shape as an ordinary oxy-acetylene torch. H_2 is used as fuel instead of C_2H_2 with O_2 and air. Describes use in salvaging sunken bridges and submarines. RHP (7b)

Rail Welding in Holland (Schienenstossschweissung in Holland) C. F. Keel. *Zeitschrift für Schweisstechnik,* Vol. 23, Sept. 1933, pages 231-232. Photograph of fusion welded rail joints. The rails have been in service for more than 6 months and show no more wear at the welds than at other points on their surface. RRS (7b)

Welding Oil and Gasoline Tanks (Das Schweissen von Tanks für Benzin und Oel) C. F. Keel. *Zeitschrift für Schweisstechnik,* Vol. 23, Oct. 1933, pages 259-260. Thick plates may be electrically welded with or without chamfering. With fusion welding it is unnecessary to reinforce the joint by welding on the inside because the joint may be welded so that external welding causes a thickening on the inner side of the joint. RRS (7b)

Fusion Welding of Rails (Autogene Schienenschweissung) C. F. Keel. *Zeitschrift für Schweisstechnik,* Vol. 23, Sept. 1933, pages 226-232. Tests at the Eidgenössischen Materialprüfungsanstalt in Zürich on fifteen rails showed a Brinell hardness through the welds of from 108 kg. with the soft welding rod, to 233 kg. with the hard welding rod. Fatigue tests were made and the results are given in a table. RRS (7b)

Fusion Welding in the Shop (Autogene Schweissung in der mechanischen Werkstatt) C. F. Keel. *Zeitschrift für Schweisstechnik,* Vol. 23, Nov. 1933, pages 276-283. Describes the various uses of fusion welding; featuring fabrication by cutting and welding as well as repair work. RRS (7b)

Fusion Welding of Rail Joints on the Schweizerischen Bundesbahn. (Autogene Eisenbahnschienenschweissung auf dem Gebiete der Schweizerischen Bundesbahn). C. F. Keel. *Zeitschrift für Schweisstechnik,* Vol. 23, Oct. 1933, pages 250-255. The joint is prepared for welding with the cutting torch. The head of the rail is welded first. After welding the joint is heat treated to remove strains. The welding rod is a hard steel containing 3% Ni. The author notes the time and amount of materials required for various types of welds. Photographs show various stages of the processes described, and one of them shows a joint after one month of use. RRS (7b)

Fusion Welding of Rails (Autogene Schienenschweissung) C. F. Keel. *Zeitschrift für Schweisstechnik,* Vol. 23, July 1933, pages 169-176; Aug. 1933, pages 198-206. Welding of rail joints has been used for about thirty years. At first the Thermit method was used, particularly for street railways where the rails are embedded in the ground. The oxy-acetylene process was next to come into common use. In this process the rail ends are heated with the oxy-acetylene flame and the additional material required is supplied by a welding rod. Only in the last few years has the application of fusion welding been possible in this field. Electric arc and electric resistance welding have also been used for joining rails. The author describes in detail the fusion welding of rails and gives examples of practical applications as well as cost data. RRS (7b)

Welding Thick Plates (Die Schweissung dicker Bleche) C. F. Keel. *Zeitschrift für Schweisstechnik,* Vol. 23, Sept. 1933, pages 235-240. The investigation reported showed that X-shaped joints on thick plates may be welded by a single welder; that gas consumption, rod consumption, and time required are less for X-shaped joints than for V-shaped joints. The reason for this is that only half as much welding rod need be added for the X-shaped weld. RRS (7b)

Overhead Welding (Ueberkopfschweissen). C. F. Keel & O. Röthlin. *Zeitschrift für Schweisstechnik,* Vol. 23, Oct. 1933, pages 262-264. Most welders fear overhead welding, but the methods are really easily learned. It is essential that a weaker flame be used in overhead welding than in horizontal welding. Gives diagrams and describes the methods used in welding: corners, semi-overhead; lap-welding, semi-overhead; lap-welding and butt welding, overhead. RRS (7b)

Soiling of Welding Torches by Metal Spattering as Function of the Holding of the Torch and its Influence on the Weld (Verunreinigung des Schweissbrenners durch Metallspritzer als Funktion der Brennerhaltung und ihr Einfluss auf die Schweissung) W. Johag. *Autogene Metallbearbeitung,* Vol. 26, Aug. 15, 1933, pages 246-248. The influence of the manner of holding the burner in practical welding upon the quality and economy of welded joints was observed; it can be concluded that the right-hand welding, that is burner preceding welding rod, has the greater advantage as the operation of the burner is not affected by soiling by spattered material; the latter does not get so easily in the weld and does, therefore, not disturb the uninterrupted progress by back-firing and readjustment of the flame. Ha (7b)

High-Frequency Arc-Welding Generator. G. A. Johnstone. *Transactions American Institute Electric Engineers,* Vol. 52, Mar. 1933, pages 279-281. See "High Frequency for Arc Welding," *Metals & Alloys,* Vol. 4, Sept. 1933, page MA 291. Ha (7b)

Practical Experiences on Electric Welding in the Shop of a Power Plant (Praktische Erfahrungen in den Betriebswerkstätten eines Elektrizitätswerkes) H. Jonas. *Elektrizitätswirtschaft,* Vol. 32, Aug. 25, 1933, pages 354-357. Paper before the General Meeting of the Vereinigung der Elektrizitätswerke, Essen, June 30, 1933, reports on experiments carried out with the object of investigating the possibilities of selling arc welding to small shops of the metal trade. The technical and economic data referring to German conditions answered the question of commercially utilizing small electric welding units in the affirmative. EF (7b)

The Design of Jigs and Fixtures for Welding. Part I. Types of Fixtures and Design Fundamentals. Owen C. Jones. *Better Enameling,* Vol. 4, Sept. 1933, pages 12-14, 29. Advantages of use of jigs and fixtures in welding are: convenience to the operator, a reduction of cost of the articles, the standardization of the article, and accuracy in fabrication. Fundamentals of design of jigs and fixtures are discussed. CBJ (7b)

Repair Welding of Poor Weld Seams and Milled Weld Seams (Über den Einfluss der Zuschweissung von schlechten Nahtstellen und angefrästen Schweissnähten) W. Lessel. *Die Elektroschweissung,* Vol. 4, Sept. 1933, pages 169-170. Tests on the deformation occurring while welding seams that have been superficially milled for examination of weld quality are described. Deformation was tested with a special apparatus which is briefly described. The width of V-welded plates varied from 20-60 mm. while section milled was always 20 mm. long. For a ratio of milled seam length to total seam length below 24% no deformation and stresses occur. Results of tensile and bending tests are given. In summarizing it is stated that weld seams milled for inspection need not be closed when weld is not subjected to atmospheric conditions or is located at a statically important point. Thermal stresses are set up upon welding milled area. Deformations occur when these areas are less than 100 mm. apart. Such spots are weak sections of the construction when milled areas of seam are less than 100 mm. apart. GN (7b)

Welded Bridge in Germany sets new Records. René Leonhardt. *Engineering News-Record,* Vol. 111, Nov. 16, 1933, page 589. Structure at Dresden consists of 13 spans, is 1,040 ft. long and required 431 tons of steel plate, shop-fabricated into girders and floor beams by an automatic welding machine. CBJ (7b)

How can the Greatest Possible Economy and Best Quality in Fusion Welding be Obtained? (Wie erzielt man grösstmögliche Wirtschaftlichkeit und beste Qualität bei der autogenen Schweissung?) J. Leeman. *Autogene Metallbearbeitung,* Vol. 26, Sept. 1, 1933, pages 264-266. Thorough preparation of all welding work safeguards good quality and uninterrupted procedure, proper selection of welding method, welding rod and burners increase economy and quality. Right-hand welding and 2-flame burner should be used wherever it is possible. Ha (7b)

Shear Strength of Resistance Welds. Grover A. Hughes. *Electrical World,* Vol. 102, Nov. 11, 1933, pages 634-636. Tests on projection welded joints with the weld in shear showed failure in the angle and not in the weld. Spot welds and flash or butt welds were tested on structural steel near the lower limit of 55,000 lbs. per sq. in. (tensile) with about 0.15% C; and on structural steel near the upper limit of 65,000 lbs. per sq. in. (tensile) with about 0.30% C. Welds were made with automatic machines. Results are tabulated. CBJ (7b)

Electric Arc Welding of Aluminum (Die elektrische Lichtbogenschweissung von Aluminium) L. Anastasiadis. *Die Elektroschweissung,* Vol. 4, Sept. 1933, pages 166-168. After discussing difficulties of welding Al, requirements which fluxes covering electrodes used have to meet are considered and results of practical tests with such electrodes are described. Whereas in former methods work piece had to be preheated this is not necessary in new method developed. It is emphasized that quality of welds essentially depends on absence of gas and slag inclusions. Tensile tests on samples welded with different fluxes showed fluctuations of tensile strength from 2-15 kg./mm.^{2} while elongation fluctuated from 5-40%. In arc welding Al and its alloys, properties of fluxes are of prime importance for quality of weld. GN (7b)

Machine Cutting Torches are Used in an Ingenious Manner for Slotting Pipe for Oil-Well Casings. W. E. Archer. *Welding Engineer,* Vol. 18, Sept. 1933, pages 24-25. Undercut slots of a greater width on the inside of the casing than on the outside are flame-cut; minimum width is 0.03". Ha (7b)

Removing the Hazards in Welding Tanks containing Inflammable Vapors. W. E. Archer. *Welding Engineer,* Vol. 18, May 1933, pages 14-15. By covering the inflammable liquid in a tank with a layer of a mixture of hydrocarbon gas and 40% CO_2 welding could safely be carried out without danger of explosion. Some examples where this method was used successfully for repairs are described. Ha (7b)

Self-supporting Roofs. A. J. T. Eyles. *Electrical Review,* Vol. 113, Aug. 25, 1933, page 252. Arc welding was used to erect sheet-steel roofs of grain elevators at Albany, N. Y. MS (7b)

A Yardstick for Buying Welded Machine Parts. Allan S. Austin. *Machinery* (N. Y.), Vol. 39, Feb. 1933, pages 397-399. Presents suggested specifications for welded steel machine parts. RHP (7b)

Progress in Welding Machine Construction (Neuer Fortschritt im Schweissmaschinenbau) W. Fink, H. Langkau & H. Bauer. *Die Elektroschweissung,* Vol. 4, Aug. 1933, pages 151-153; Oct. 1933, pages 196-197. Fink refutes advantages of new self-exciting welding machines as described by Langkau in Die Elektroschweissung, Vol. 4, Mar. 1933, pages 48-50. Bauer particularly refers to efficiency of new machine which he does not consider to be favorable. GN (7b)

What the Electric Welder Should Know about the Theory of the Electric Arc (Was muss der Schweisser von der Lichtbogentheorie wissen?) Wilh. Fink. *Die Elektroschweissung,* Vol. 4, Oct. 1933, pages 181-187. In easily comprehensible manner paper deals with theory of electric arc as far as it plays a role in welding occurrences. The chapters consider: (1) electric arc as paths of electrons and ions, (2) the cathode spot as emitter of electrons, (3) voltage conditions of electric arc, (4) characteristic and stability of electric arc, (5) control of welding current, (6) a.c. arc, rectifier effect, (7) electromagnetic deflection of arc. In summarizing author states: (1) In d.c. welding it is advisable to put hotter positive pole on work piece, (2) in a.c. welding only coated and special alloy electrodes and core wires can be used, improving ionization of arc, (3) also in a.c. welding differences of heating up electrode and work piece are apparent, (4) control of welding current can be effected either by changing idling voltage of welding machine or by changing series resistance or adding reactance coil in welding current circuit. GN (7b).

German Conventional Symbols for Welding. Otto Bondy. *Engineering,* Vol. 135, May 5, 1933, pages 479-480. Tables are given reproducing a number of symbols drawn up recently by a section of the Committee for Welding of the Association of German Engineers. Explanations are given as to their origin and application in practice. LFM (7b)

The Usefulness of Jigs in Welding High-Nickel Alloys. F. G. Flocke, J. G. Schoener & R. J. McKay. *Sheet Metal Worker,* Vol. 24, Aug. 1933, pages 260-261. Methods of arranging jigs to facilitate holding parts in place to be welded and oxy-acetylene welding process for monel metal, inconel and pure Ni are described. Ha (7b)

The Welding of Inconel. F. G. Flocke, J. G. Schoener & R. J. McKay. *Welding Engineer,* Vol. 18, Nov. 1933, pages 22-26. Information on welding procedure and physical properties of inconel (80% Ni, 14% Cr, 6% Fe) are described. Weld and material can be easily polished and a high finish given where needed, as for instance for containers and equipment in the food industries. Examples are illustrated. Ha (7b)

The Fundamental Characteristics and Technique of Spot-Welding of Various Metals. Lawrence Ferguson. *Welding Engineer,* Vol. 18, July 1933, pages 14-16; Aug. 1933, pages 20-23. Processes, apparatus and technique of spot-welding are discussed. Spot-welding possibilities of different metal combinations are considered, a chart showing which of 250 combinations can and cannot be spot-welded is given. Ha (7b)

Electric Welded Dredger (Elektrisch geschweisster schwimmender Greifbagger "Dörverden" für den Bezirk der Wasserstrassendirektion Hannover) Foss. *Schiffbau, Schiffahrt und Hafenbau,* Vol. 34, Oct. 1, 1933, pages 333-338. The construction of the 22.5 m. long dredger assembled exclusively by electric welding is described in very great detail with emphasis on the advantages of the joining method. WH (7b)

New Specifications of the German State Railroad for Welded Rolling Stock (Zur neuen Reichsbahnvorschrift für geschweisste Fahrzeuge) Füchsel. *Organ für die Fortschritte des Eisenbahnwesens,* Vol. 88, Nov. 15, 1933, pages 435-437. Under weldable material fire box copper and cast steel are admitted. In comparison with the German welding standards DIN 4100, 25% higher load of the weld is allowed revealing the great confidence in the advance of welding technique. Welding alongside riveting on the same joint is prohibited. The qualification test of welders has been rendered more difficult. Not only welders and welding engineers are submitted to supervision, but the German State railroad also looks into the welding facilities of the outside welding shops. Special tensile and bending tests and, for the first time, impact tests are provided for "high quality" welded seams. WH (7b)

Evolution of Fusion Welding as Seen in Technical Literature (L'Evolution de la Soudure Autogène et la Presse Technique) C. Franche. *La Technique Moderne,* Vol. 25, July 1, 1933, pages 464-466. Gives briefly the substance of 28 articles published in various world welding and other technical reviews. FR (7b)

Welding Copper by the "Long Arc" Method. W. F. Chafee. *Welding Engineer,* Vol. 19, Sept. 1933, pages 20-23. A new technique of arc welding Cu requires the use of a special filler rod, "Hobronz" (of rapid flow at comparatively low temperature; composition not given), and a welding machine giving full amperage with a long, high-voltage carbon arc. High speed, lack of warpage and high strength of the weld without much reduction in the strength of the parent metal is claimed; examples of welding large tanks, vaults, pans, etc. are described. Test of welded Cu seams revealed a strength of 23000-25000 lbs./in.^{2} Ha (7b)

Supervision of Arc Welded Construction. A. S. Coombs. *American Architect,* May 1933, pages 51-52. Qualification test of welders, employment of qualified inspectors, examination by X-rays and selection of proper electrode material are mainly discussed. Nearly 300 structures have been built in the U. S., which are wholly or partially welded with not a single reported failure. WH (7b)

Fusion Welded Reinforcement (Autogen geschweisste Unterstutzungskonstruktionen) M. Greger. *Zeitschrift für Schweisstechnik,* Vol. 23, May 1933, pages 129-130. Investigations have shown the fatigue strength of fusion welds made with plain soft charcoal iron rods to be 75-80% of that of the material welded. With use of higher quality rods it should be possible to develop 100% of the strength of the material, particularly with 37-Steel. Describes various types of welded reinforcements. RRS (7b)

The Progress of Electric Arc Welding in the United States Navy. John D. Crecca. *Welder,* Vol. 5, Sept. 1933, pages 9-18. Methods and materials, ferrous and non-ferrous are discussed and design features described. Ha (7b)

Weldability of Structural Steel 52 (Laschbaarheid van constructiestaal St.52) W. Gerritsen & P. Schoenmaker. *Polytechnisch Weekblad,* Vol. 27, July 27, 1933, pages 465-475. Paper before the Vereenigung voon Laschtechniek, Utrecht, April 1933, and Amsterdam, May 1933, on the welding properties of the standard German structural steel St. 52 covering the following analysis ranges according to the different manufacturers:

	Mn	Cr	Mo	Cu
Gutehoffnungshütte	1.0-1.3	....	0.15-0.25	0.35
Union	0.7-1.0	0.4-0.6	....	0.6-1.0
Krupp	1.2-1.6	....	....	0.3-0.6
Lauchhammer	0.9-1.1	....	....	0.5-0.6

Microstructures taken from the virgin metal and at progressive distances through the weld are presented. Diagrams reveal the course of hardness through a V-weld. A moderate gain is noticeable in the border region between weld and work while a distinct drop takes place in the seam. Further hardness diagrams refer to different weld materials showing that a gain or practically constant hardness in weld and virgin metal can be ascertained. The results of bending tests are also graphically presented accomplished alongside hardness tests. Five tables show data on bending properties of X-welds, and on impact strength, elongation, reduction of area taken on round test bars as well as fatigue properties as established in the Schenck fatigue testing machine. Fracture never occurred in the transitional region between parent metal and weld material. WH (7b)

Water Storage Tank Is Arc Welded. B. Ferguson. *Iron Age,* Vol. 131, Apr. 27, 1933, page 663. Describes the electric welding of a 6,000,000-gal. water storage tank by the A. O. Smith Corporation. VSP (7b)

Selection of the Use of Tubes in Welded Construction (Détermination de l'Emploi du Tube dans la Construction Soudée) H. Gerbeaux. *Revue de la Soudure Autogene,* Vol. 24, Oct. 1932, pages 2614-2619. Tubes are not suitable for riveted construction in which simple joints are essential, but can reasonably be resorted to in some instances which are described in the article. It must be kept in mind that price of tubes is 2.7-3 times that of common profiles. It is indicated that tubes are not suitable for members subjected to tension or to transverse stress, that they are of much interest for members of great length subjected to compression lengthwise or those submitted to torsional stress. For light parts to sustain stresses in all directions tubes are of much interest. Conclusions arrived at are: apart from mechanical advantages tubes show others which are more difficult to figure such as: tubes are more easily painted and protected against corrosion. They can be used in some construction for conducting fluids. They can readily be welded using the oxy-acetylene process. Owing to their resistance to torsional and lengthwise stresses they are less subject to shrinkage distorsions during welding. In some instances they lead to more attractive construction such as when tubes of relatively large diameter are used for girders. Chief objection to development of use of tubes is their high price but it is hoped that progress in manufacturing methods particularly in production of welded tubes will lower their price. FR (7b)

Arc Welding of Steel (Probleme der Lichtbogenschweissung von Stahl) A. Fry. *Die Elektroschweissung,* Vol. 4, Nov. 1933, pages 201-209. Paper before Tagung für Elektro-schweissung, July 20, 1933, Essen. Author critically considers a few of the most important but still disputed problems of electric arc welding of steel and deals with (1) static and dynamic strength of arc welds and conclusions on welded constructions derived from such tests, (2) stresses and cold deformations, (3) sensibility to hardening occurrences of steels used for welding, (4) corrosion of welded constructions. In the first chapter the importance of fatigue tests especially of alternating tensile tests is stressed. Since fatigue failures generally start from inclusions and blowholes elimination of such defects is the first aim of proper welding. Tests for determining the effect of blowholes on the fatigue limit of welded constructions are described showing that not only the extent of the blowholes has a bearing on the fatigue properties. The effects of a superheated structure are considered in welding steels free from aging (Izett IV with rods of austenitic structure). Tests seem to prove that the detrimental effect of the formation of a coarse grain in the upper layers of welds is generally overestimated. Conclusions are drawn on the suitable development of welded constructions. In the 2nd chapter stresses as well as deformations due to welding and the methods for eliminating them are discussed. Welded parts should be so constructed that stresses and cold deformations are reduced to a minimum. Caustic brittleness is touched upon. The sensitivity of steels to hardening occurrences plays an important role when steels of high tensile strength (for instance St. 52) are welded. The sensitivity of such steels can be counteracted by special alloying constituents. Finally corrosion occurrences are briefly considered. Potential measurements are insufficient for judging the corrosion stability of weld seams. All the tests described go to show that many of the doubts advanced against electric arc welding are not justified. 9 references. GN (7b)

Atomic Hydrogen Welding Solves Heat Exchange Equipment Problem. M. W. Brewster. *Iron Age,* Vol. 131, Mar. 16, 1933, pages 434-435. Describes the welding of No. 16 gage tubing, ¾ in. in diameter, into a 1 in. thick tube sheet by atomic H welding at the plant of Witlock Coil Pipe Co., Hartford. The process enables the firm to weld successfully thin tubes to thick headers and to other jobs which are impractical by other welding processes. VSP (7b)

Classification of Welded Seams (A Propos de la Classification des Soudures) H. Gerbeaux. *Revue de la Soudure Autogene,* Vol. 24, Nov. 1932, page 2634. It is surprising to note in technical literature the numerous tests for welds. This proves that there is a lack of effective unification of tests in view of weld classification. First of all, basis of classification must be the knowledge of use of welds. Knowing value of stress which will be applied on a weld it is easy to select suitable kind of weld and then taking account of tests suitably classified it would be possible to determine way of making the weld and to know time necessary and cost for the work. Up to date classifications of welds have been proposed but they are generally too simple which reduces their usefulness. According to the author, following classification should be of interest: Simple tough welds. Welds having to sustain simple shearing. Welds for resisting fatigue (a) under shearing, (b) under tension. Welds only fluid-tight. Tough and tight welds, etc. Corrosion resistant welds, etc. Tough welded coatings. Hard welded coatings. Wear or impact resistant welded coatings, etc. Name of class would be sufficient for selecting kind of test to be resorted to and for determining requirements to be answered and way to perform work. FR (7b)

Use of Torch in Laying Underground Steel Tubes (L'emploi du Chalumeau dans la Pose des Canalisations Souterraines en Acier) M. Berriat. *Bulletin de la Société des Ingénieurs Soudeurs,* Vol. 3, Nov.-Dec. 1932, pages 751-779. Lecture before the French Welders' Association. Different kinds of joints previously used for assembling pipes are first reviewed. Dealing with new process i.e. welding, it is shown that butt welding of tubes is chiefly used in America whereas in Europe welding on tubes overlapping in joints has prevailed. Stresses which tubes have to sustain are studied. Stresses due to atmospheric effect, particularly cold, by vibrations and shocks can be very important and very often cause breakage of steel tubes out of joints. To remedy this fact overlapping joints are used and welds are made so that they are less resistant than tubes, for realizing this point, soft metal welding rods are resorted to. If too high stresses are developed in pipe line a breakage happens through weld and the outer tube slides somewhat along the inner one, thus there is only a minor leakage which can be stopped without difficulty by using a special casing in two parts bolted one upon the other. Welding of tube is always made, when possible, out of trenches for allowing better practice and control and then let down in trenches: this handling serves as a sort of test showing quality of work done. In last section of lecture, details are given concerning welding practice: torch capacity, etc. FR (7b)

Effect of the Length of Welded Seams on Their Tensile Strength (Einfluss der Länge von Flankennähten auf ihre Festigkeit) C. J. Hoppe. *Die Elektroschweissung,* Vol. 4, Nov. 1933, pages 215-216. Results of investigations by E. O. Paton & W. W. Schewernitzky at Ukrainian Academy of Science. Compression tests were made on 5 various types of welded test samples showing that though the ultimate loads sustained increase upon increasing the length of the seam the load increase is not directly proportional to the seam length. GN (7b)

Rectifiers for Seam Welding Machines (Stromrichter für Nahtschweissmaschinen) W. Leuckert & G. Falck. *Siemens Zeitschrift,* Vol. 13, special edition, Oct. 1933, pages 285-288. Welding of sheets of low quality must be done with frequent interruptions of current so that the seam consists of welded spots in close succession. This is accomplished automatically in regular intervals by inserting into the welding transformer circuit rectifier tubes which interrupt the current by changing the grid potential of the rectifier tubes in the desired manner. Operating results are published. The arrangement is said to simplify the mechanical uninterrupted advance between the rollers of the material to be welded, to give seams of better quality, and to adjust off and on time of the welding current at will independent of mechanical conditions. Ha (7b)

Pressure Tests on Fusion Welded Small Containers (Druckversuche an gasgeschweissten Kleinbehältern) K. Liedloff. *Autogene Metallbearbeitung,* Vol. 26, Mar. 1, 1933, pages 69-70. 2 tests on small containers made of thin sheet material have proved again that a properly made weld is superior to any other kind of joint and that fusion welding is an absolutely reliable method in the hands of an expert welder. Ha (7b)

Use of City Gas for Welding and Cutting (Verwendung von Leuchtgas zu Schweiss- und Schneidzwecken) Alex. Matting. *Forschungsarbeiten auf dem Gebiete des Schweissens und Schneidens mittels Sauerstoff und Azetylen,* Series 8, 1933, pages 30-35; *Autogene Metallbearbeitung,* Vol. 26, July 1, 1933, pages 198-203. Cost of welding could be reduced if, instead of C_2H_2 or H which must always be transported in containers, the cheaper and almost always obtainable illuminating gas could be employed. Methods using the gas either pure or as an admixture to other gases were critically investigated, but it can be stated that the economic advantages do not warrant the general use of illuminating gas, especially as no improvement of the weld can be expected. Ha (7b)

Rational Use of Arc Welding (L'Utilisation Rationnelle de la Soudure Electrique à l'Arc) R. Meslier. *Revue de la Soudure Autogene,* Vol. 24, Nov. 1933, pages 2635-2637. During the last few years arc welding method and apparatus used have been improved which broadens scope of application of process, but it is thought that arc welding is sometimes unduly adopted. For instance author has seen construction by arc welding, troughs with thin sheets of 2-4 mm. Giving details of calculation, it is shown that, for a 4 mm. sheet, price of 1 meter arc welded seam is 3.75 frs. whereas that of 1 meter of oxy-acetylene welded seam is 2.55 frs. Those prices which refer to industrial shop conditions show that in this case arc welding is more expensive than oxy-acetylene welding. In last section of article examples are given of judicious use of arc welding process, i.e. construction of (1) steel poles weighing 700 kg. each. (2) Small machine frame made with plate of 10-25 mm. thickness. (3) Machine base weighing 284 kg. and (4) Turbo-alternator of 5.4 m. diameter weighing 8000 kg. Illustrations are given. FR (7b)

Experiments to Determine the Most Favorable Working Conditions for Welding of 4-12 mm. Iron Sheet (Versuche zur Festlegung der günstigsten Arbeitsbedingungen für Eisenblechschweissung 4 bis 12 mm.) H. Melhardt. *Forschungsarbeiten auf dem Gebiete des Schweissens und Schneidens mittels Sauerstoff und Azetylen,* Series 8, 1933, pages 7-18; *Autogene Metallbearbeitung,* Vol. 26, July 15, 1933, pages 210-221. Results of experiments made in the Vienna Welding Institute are summarized in a table showing the most important factors as a function of the thickness of the sheet. Data given are for high quality weld with 20% increase of section and with simultaneous formation of an underseam. It is of great importance to approach and maintain during welding the width of slit between the 2 sheets as closely as possible to the values given. Ha (7b)

Welded Steel Diesel Structures. Everett Chapman. *Industry & Welding,* Vol. 6, Sept. 1933, pages 4-9, 29-31; *Railway Mechanical Engineer,* Vol. 107, Oct. 1933, pages 352-357. Description of building of crankcase and structural parts of a Diesel engine with welded steel parts replacing cast Fe; reduces moment of inertia and total weight. Ha (7b)

Elastic State of Welded Seams (Etat Elastique des Cordons de Soudure) E. Hoehn. *Chaleur et Industrie,* Vol. 13, Aug. 1932, pages 504-510. Lateral seams of discontinuous butt straps (lap joints) are chiefly subjected to shearing stress. When butt straps are welded on their periphery, maximum shearing stress is not so important. Therefore, frontal seams have relieved lateral seams at their ends. Shearing stresses which develop in lateral and frontal seams are due to relative displacement of the plate and the butt straps. It can be accepted that shearing stress is proportional to displacement. Process of displacement is complex. When a hoop iron is welded on a plate, for instance a diagonal member on a gusset, and is subjected to tension, normal stresses have generally not the same value in the member and in the plate. Difference in elongation between the two parts results, according to Hook's law, into relative displacements. The latter must be thoroughly studied when designing a welded structure. FR (7b)

Welding Corrosion-Resistant Irons and Steels. James Campell Hodge. *Refiner & Natural Gasoline Manufacturer,* Vol. 12, May 1933, pages 189-197. 8 types of stainless steels are discussed, 4-6%, 12%, 16%, 18%, 28% Cr, 18-8 Cr-Ni, 25-20 Cr-Ni, and 8-20 Cr-Ni. Welding metal used for each type, the chemistry of corrosion-resistant weld metals, various heat treatments used after welding to produce maximum ductility and softness, and typical microstructures are presented for each type of steel. Effect of coated and uncoated electrodes are discussed. Carbide precipitation of Cr-Ni austenitic as related to welds is discussed and illustrated. In many cases heat treatment after welding is not convenient. It has been found that the addition of Ti in an amount equivalent to about 6 times the C content is effective in reducing the carbide precipitation during welding. It is especially effective on plates of thin sections. Stainless clad materials on C steels are welded readily with 18-8 electrodes for the stainless side and with C electrodes on the C steel side. Such welds are not readily heat treated due to the composite structure. In the 4-6% Cr type weld additions of W or Mo improve the high temperature strength and prevent temper brittleness. Due to the air hardening properties this type does not weld with ease, and a careful heat treatment is necessary. 18-8 electrodes are used. The 12% Cr type offers similar difficulties. Alloys of the 16-18% Cr type weld quite easily and are simply annealed at 1500° F. Ni-Cr austenitic steels weld readily producing a strong and ductile weld. Considerable data are presented on this type of alloys. WAT (7b)

Development of an Arc-welded Portable Band Saw Mill. Geo. E. Campbell. *Industry & Welding,* Vol. 6, July 1933, pages 18-20. Full description of the portable installation of welding steel. Ha (7b)

Copper-Hydrogen Welding A Quantity-Production Process. W. W. Anderson. *Iron Age,* Vol. 131, Apr. 6, 1933, pages 538-539. Cu-H welding is the welding of ferrous metals by passing them through a H-filled, electrically heated zone at 2100° F. Cu which has been applied to seam, alloys with Fe to form a gas-tight bond. Bond is stronger than the metal itself. The process is used by Bundy Tubing Co. The Zeppelin-type furnace used is capable of handling as many as 1000 pieces at one time, size being the only limiting factor. VSP (7b)

Automatic Butt Fusion Welding Machine as Machine Tool. (Die selbsttätige Stumpfabschmelz-Schweissmaschine als Werkzeugmaschine.) W. Kuerschner. *Elektrowärme,* Vol. 2, Oct. 1, 1932, pages 227-229. The various successive stages of preparing, adjusting and final welding of quantity products in one automatic welding machine are illustrated by the manufacture of window sashes and frames of profile iron. Ha (7b)

Practicability and Joint Characteristics of Arc-Welded Industrial Piping. Robert Daniels & Warren C. Hutchins. *Journal American Welding Society,* Vol. 12, Jan. 1933, pages 4-9. Paper presented at joint meeting of New York Section, American Welding Society and the Petroleum and Power Division of the American Society of Mechanical Engineers, Dec. 13, 1932. Practical economics of electric arc welding for industrial pipe joints has not yet received the full recognition it deserves. Authors discuss this subject under following headings: Securing competent welders, layout of piping, shop vs. field welding, preparation and welding of pipe joints, inspection of welds, cost, advantages of welded pipe joints and tests of welded pipe joints. The following conclusions are drawn from data obtained in a series of tests of 6 in. arc welded joints: (1) The physical properties of arc-welded pipe joints are superior to pipe joints made by other methods for the following reasons: Average tensile strength—above 60,000 lbs./in.^{2} Average ductility by free-bend test—45%. Freedom from slag inclusions and porosity come well within the A.S.M.E. Boiler Code requirements for Class II Pressure Vessels. (2) Heavily coated electrodes are to be preferred over bare or lightly coated electrodes because of the quality of welds produced. (3) Two distinct types of heavily coated electrodes should be used if maximum economy is to be obtained; one for roll welds and the other for position welds. (4) The straight butt joint with chill ring is to be preferred over other types. (5) The fusion ring or reinforcing liner (often called chill ring) is essential to the well-made pipe joint. (6) Two passes instead of three are to be preferred on 6 in. pipe joints due to the saving in time and expense. (7) Position welded joints made with fusion rings are closely comparable in strength to roll welds made under similar conditions. (8) The ductility of all types of welded pipe joints made with the electric arc and heavily coated electrodes approaches that for the pipe material more closely than does any other type of pipe joint. (9) The density of the weld metal is comparable with that of the pipe material and the resistance to impact and corrosion is greater. A number of arc-welded industrial piping installations are described. TEJ (7b)

Welding of Pressure Vessels. Jules Muller. *Journal American Welding Society,* Vol. 12, Apr. 1933, pages 7-10. Paper presented before Feb. 1933 Meeting, Chicago Section, American Welding Society. Discusses metallic arc welding of pressure vessels with particular reference to the tests required by the A.S.M.E. Code. TEJ (7b)

Welding of Rust-, Acid- and Heat Resistant Cr and Cr-Ni Steels. (Schweissen von rost-, säure- und hitzebeständigen Cr und Cr-Ni-Stählen.) F. Leitner. *Die Schmelzschweissung,* Vol. 11, Sept. 1932, pages 188-191; Oct. 1932, pages 212-216. An exhaustive investigation showed that in steels with about 13 to 15% Cr the resistance against corroding influences decreases with increasing C due to formation of Cr carbide so that the steel becomes lower in free Cr content. Steels with 0.4-0.5% C and 14% Cr are preferably used in cutlery and show their highest corrosion resistance in hardened and annealed state. When welded the tensile strength is increased to 160-170 kg./mm.^{2} Steels with 18% Cr are chemically more resistant than with 14% Cr. Higher Cr contents are used for objects which have to stand elevated temperatures, 20% Cr for 950° C., 30% for 1050° C. The steels should be alloyed in such manner that they fall in the range of the transition from δ to γ phase as here welding does not effect an increase in strength and the tendency to formation of coarse grain is restricted. The loss by scaling at 1000° C. amounts to 0.60 g./cm.^{2}/24 hrs. $\times$ 10^{-3} for 30% Cr, while ordinary open-hearth steel has 860 g./cm.^{2}/24 hrs. $\times$ 10^{-3}. The flame for fusion welding must be adjusted for a slight excess of gas, especially for high C steels. The constitutional diagram of Cr-Ni steels is given and shows how the addition of Ni changes the structure, for instance from ferritic to austenitic. As a consequence such steels cannot be hardened and are soft, tough and non-magnetic. They are extremely resistant to chemical action. The heat conductivity is only about ⅓ to ¼ that of mild steel, heat-expansion about 50% greater. Heating to 500°-900° C. segregates carbides which are again dissolved at temperatures above 900° C. Although in welding all temperatures are passed no ill effects have been observed in spite of carbide segregation. For electric welding suitably coated electrodes should be used, the current should be 90-110 amp. for 3 mm. electrodes, 120-150 amps. for 4 mm., and 160-180 amps. for 5 mm. electrodes. Several microphotographs show the fine structure of such gas and electrically welded pieces. Heat resistant steels for 1100° C. contain about 16-25% Cr and 18-25% Ni. Loss by scaling is 1.2 g./cm.^{2} $\times$ 10^{-3}/24 hrs. For 1200° C., alloys with 15-25% Cr and 35-45% Ni are used, for 1300° C. 50-70 Ni and 15-25% Cr. They can be welded and show the same qualities as the lower alloyed steels. Ha (7b)

Qualified Welders Make Joints Strong and Uniform. H. Malcolm Priest. *Metal Progress,* Vol. 22, Dec. 1932, pages 29-33. The results of the Structural Steel Welding Committee of the American Bureau of Welding's survey of commercial gas and electric welding practice are given. The qualification tests of the welders and a summary of the work of each welder on the program specimens are presented graphically. The strength of butt and fillet welds is shown in sketches and tables. Effect of eccentricity is also shown in sketches, tables, and graphs. A wedge test and tension test for structural welds are described. The welders who made the best showing in the qualification tests also made the strongest welds in the program tests. WLC (7b)

Welded Bearing Bosses. V. A. Prince. *Welder,* Vol. 4, Oct. 1932, pages 19-22. Examples of bearing bosses welded directly to a supporting plate are described; this method resulted in a saving in cost over the employment of the usual spigotted casting bolted in position. Ha (7b)

Selecting and Using Welding Rods. Stuart Plumley. *Welding Engineer,* Vol. 17, Dec. 1932, pages 25-29. Influence of chemical composition, in particular C content of an electrode on weld penetration is explained and compositions for electrodes for welding different materials, ferrous and non-ferrous, are given. Ha (7b)

Welding Shop Management. A. Robinson. *Welder,* Vol. 4, Jan. 1933, pages 1-6. Apart from considerations of cost, a dependably high standard of quality can only be obtained in a welding shop by the control of: (a) correct design of the welded product, (b) control of material and welding equipment, (c) control of welding technique and subsequent testing of finished product. TEJ (7b)

Welding of High Manganese Steel. E. J. Schuler. *Welding Engineer,* Vol. 18, Apr. 1933, pages 19-20. Welding technique for maintenance and repairing railroad material of high Mn steel, as crossings, frogs, etc. is discussed and best procedures described. Care must be taken that the weld is kept liquid long enough to let gases escape as the metal boils very slowly and often solidifies before the gases could escape. The finished weld is to be ground. Ha (7b)

Arc Welding in the Mining Industry. (Die Lichtbogenschweissung beim Bau von Förderanlagen.) W. Schüller. *Zeitschrift für wirtschaftliche Fertigung,* Jan. 15, 1933, section 6, page 1; Feb. 15, 1933, page 3. Production of mine cars by welding is discussed at length and compared with riveting. The material costs for riveting and welding are about the same, however, 25-30% in labor can be saved by welding. Furthermore welded cars are more durable. Fatigue tests on various types of welds are described. Arc welding is suitable to be applied also to repair work, as examples show. The greater rigidity of welded constructions is pointed out. Also in cases where deformations should occur owing to heavy shocks welded construction can easily be straightened out. GN (7b)

On the Present Status of Welding Steel Structures. (Über den augenblicklichen Stand des Schweissens von Stahlbauten.) Kommerell. *Stahlbau,* Vol. 6, Mar. 17, 1933, pages 41-45. Discusses methods of improving welding technique, effect of shrinkage stresses on loading of weld seams, girder plates on sheet beams, reinforcements on welded sheet beams, and flange profiles used on welded sheet beams. GN (7b)

A New Type of Welding Course. L. F. Jackson. *Journal American Welding Society,* Vol. 12, May 1933, pages 17-18. Presented at Business Session, Annual Meeting, American Welding Society, April 27, 1933. The common run of welding courses fall into one of 2 classifications: highly technical courses in metallography in the Colleges and Universities and the practical courses given in trade schools. The author outlines a course which should satisfy the requirements of the average engineer and operator more fully than any other course. TEJ (7b)

Better Piping at Lower Cost with Welded Fittings. W. J. Johnston. *Power,* Vol. 76, Dec. 1932, pages 284-285. Superiority of welded pipe fittings over threaded or flanged joints in cost, convenience and efficiency is described. AHE (7b)

Determination of Initial Stresses in a Locomotive Wheel Repaired by Welding. (Die Ermittlung der Vorspannungen in einem durch Auftragsschweissung ausgebesserten Lokomotivreifen.) S. Sandelowsky. *Elektroschweissung,* Vol. 4, Feb. 1933, pages 33-35. Abstract of the author's doctor thesis (Die Bruchgefahr bei aufgeschweissten Radsätzen) before Technische Hochschule Berlin-Charlottenburg. The temperature distribution in the wheel cross-section during welding and cooling was measured at 10 spots. These were used for calculating the shrinkage stresses and initial stresses set up in the wheel. GN (7b)

The Welding of High-Speed Steel. L. Sanderson. *Welder,* Vol. 4, Nov. 1932, pages 23-29. In order to form tools of high-speed steel as cheaply as possible tips of especially hard material are welded to steel shanks by oxyacetylene, electric butt welding and flash-welding. Respective advantages are discussed; the last method is rapidly supplanting the other method where large numbers of pieces have to be handled, as it is quick and reliable. Ha (7b)

Stresses in Butt-welds. A. C. Vivian. *Welder,* Vol. 4, Mar. 1933, pages 1-6. A single V butt-welded test specimen which has warped in welding is likely to show low strength when tested in tension because of: (1) Non-uniform gripping, and (2) eccentric loading. Internal stresses and stresses produced due to differences in temperature are discussed. TEJ (7b)

Modern Pipe Installation for Long Distant Transport. (Moderne pijpleidingen voor lange-afstandtransport.) V. J. van Lint. *Polytechnisch Weekblad,* Vol. 26, July 28, 1932, pages 469-473. Preparation of soil and pipe installation by welding using electrodes with 0.15% C, 0.4% Mn, 0.55% Si. Mainly discusses American accomplishments. WH (7b)

Production and Maintenance Profited by these 16 Welding Applications. G. A. Van Brunt. *Factory Management & Maintenance,* Vol. 91, May 1933, pages 180-181. Descriptive. RRS (7b)

Electric Welding of the Cast Iron Housing of a 160 Ton Forging Press. (Elektrische Schweissung des Graugussständers einer 160 t. Schmiedepresse.) Titscher. *Elektroschweissung,* Vol. 4, Feb. 1933, pages 28-30. After discussing various types of failures occurring in large cast steel or cast iron pieces author describes repair by electric welding of broken forge press housing. The results of microscopic examinations of samples taken near the fracture are given. GN (7b)

The First Bronze Welding Electrode. John A. Tansley. *American Machinist,* Vol. 76, Mar. 24, 1932, page 389. An account of the beginning of arc welding with non-magnetic metals. The idea was suggested by Benjamin F. Lee, put into effect by John A. Tansley, improved upon by Mr. Bauer, and the test pieces were welded by Edward Kick. RHP (7b)

The Welding of Stainless-Clad Steel. S. L. Ingersoll. *Welding Engineer,* Vol. 17, Oct. 1932, pages 27-28. Steel sheets with stainless steel surface can be welded in much same way as any other bi-metal; up to about No. 10 gage an ordinary butt-weld is made using a stainless steel electrode. If stainless surface exceeds No. 10 gage a 45° bevel should be made on each side of the butt. Ha (7b)

Some Speculations into the Explanation of Fusion. C. J. Holslag. *Journal American Welding Society,* Vol. 12, Apr. 1933, pages 18-19; *Welding Journal,* Vol. 30, May 1933, pages 146, 155. Presents a unique explanation of the mechanism of fusion of metals. TEJ (7b)

Shielded Metallic Arc Process. C. J. Holslag. *Journal American Welding Society,* Vol. 12, Jan. 1933, pages 24-25. Discussion of shielded metallic arc welding process including some comments on proper procedure and results obtainable. TEJ (7b)

Electric Resistance Welding. F. C. Hohs. *Sheet Metal Industries,* Vol. 6, Dec. 1932, pages 534-536; Jan. 1933, pages 597-600. Short discussion of spot welding process with most of article given over to description of particular machine and controller. AWM (7b)

Control Instrument for the Examination of Weld Seams During Welding. (Kontrollgerät für die Untersuchung von Schweissnähten während der Arbeit.) H. Hoffmann. *Technische Blätter der deutschen Bergwerkszeitung,* Vol. 23, Apr. 30, 1933, page 252. Description of an apparatus to be used in electric welding for testing the quality of seams while making them. GN (7b)

Spot Welding of Stainless Steel as Applied to Aircraft. Carl DeGanahl. *Sheet Metal Industries,* Vol. 6, May 1932, pages 54-55. See *Metals & Alloys,* Vol. 4, Mar. 1933, page MA 74. AWM (7b)

Resistance Welding Applications. M. L. Eckman. *Industry & Welding,* Vol. 4, Oct. 1932, pages 12-15; Dec. 1932, pages 22-24. Describes a number of small articles as lamp sockets, radio parts, grates, etc. where great quantities are economically produced by flash-, butt-, spot, seam- and line-welding. Ha (7b)

A New Process for Making Welded Joints. H. S. George. *Sheet Metal Industries,* Vol. 6, Oct. 1932, pages 369-375. Paper at the annual meeting of the American Welding Society. See *Metals & Alloys,* Vol. 4, Apr. 1933, page MA 118. AWM (7b)

What must the Expert Welder know about Metallography? (Was muss der Schweissfachmann von der Metallographie wissen?) Hans A. Horn & K. Tewes. *Die Schmelzschweissung,* Vol. 11, Oct. 1932, pages 225-227; Dec. 1932, pages 261-264. Deals with the methods of improving the natural structure of a weld which is often harmful to further treatment; the mechanical treatment by hammering and thermal treatment by annealing or multiple-layer welding are discussed, microphotograms of raw and refined structures shown and a table given showing all components of a structure of Fe-C alloys, where they occur, their chemical and physical condition, their appearance after etching with alcoholic HNO_3, hardness, and brief remarks as to their behavior. 11 references. Ha (7b)

British Practice in Welding of Steel Structural Work. James Caldwell. *Engineering,* Vol. 134, July 1, 1932, pages 23-24. From paper read before International Association for Bridge and Structural Engineering, Paris. See *Metals & Alloys,* Vol. 4, Jan. 1933, page MA 13. LFM (7b)

Welded Wide Flange Beams. (Geschweisste Breitflanschträger.) Fr. Huth. *Technische Blätter der deutschen Bergwerkszeitung,* Vol. 23, Feb. 12, 1933, page 85. Description of welding, use and advantages of large beams. Rolling of large beams of structural steel St. 52 is impossible so far. By welding, large broad flange beams of this steel can be made. See also *Technische Blätter,* Vol. 23, Feb. 26, 1933, page 124. GN (7b)

Welding and Earthquake Resistance. Conrad W. Hamann. *Welder,* Vol. 4, Apr. 1933, pages 8-14. Describes a riveted and welded joint used in construction of a steel frame building. This method was used to resist the lateral stresses of earthquake shock. TEJ (7b)

Welding of Railway Bridges on the L. N. E. R. F. E. Harrison. *Railway Engineer,* Vol. 53, June 1932, pages 215-224. Description of reconstruction by electric welding of floors of weak bridges on a line carrying heavy traffic near Newcastle and some notes on all-welded bridges. WH (7b)

Plate Fabrication as applied to Tanks and Pressure Vessels. H. C. Boardman. *Welding Engineer,* Vol. 18, Feb. 1933, pages 12-15. Methods used by Chicago Bridge & Iron Works in fabricating large electric welded storage tanks for liquids and gases are described. Spherical and cylindrical vessels are built, and sequence in welding is explained in detail. Ha (7b)

Repair of Boilers by Welding. (Reparaturen an Dampfkesseln, Dampfgefässen und Apparaten durch Anwendung der zugelassenen Schweissverfahren.) F. A. Birke. *Apparatebau,* Vol. 45, Jan. 20, 1933, pages 1-6. See *Metals & Alloys,* Vol. 3, Aug. 1932, page MA 250. GN (7b)

Welded Alloy Bucket Tips Cut Trenching Costs. George Sykes. *Engineering News-Record,* Vol. 110, Feb. 16, 1933, page 215. New cutting edges of a wear-resisting alloy (Co, Cr and W) were welded on worn bucket lips. Restored teeth had much longer life. CBJ (7b)

Commonwealth Edison Welding Training Program. J. F. Sullivan, Jr. *Journal American Welding Society,* Vol. 12, Apr. 1933, pages 15-16. Paper presented at Dec. 16, 1933 Meeting, Chicago Section, American Welding Society. Details of a welding training course with some observations of results. TEJ (7b)

German Railroad Signal Station. O. Sudergath. *Industry & Welding,* Vol. 5, Feb. 1933, pages 2-6, 30. Detailed description and calculation of a signal station entirely welded of structural parts. Ha (7b)

Boat Built by Fusion Welding. (Autogen geschweisste Schiffe.) *Zeitschrift für Schweisstechnik,* Vol. 23, Feb. 1933, pages 44-45. Brief illustrated description of a welded boat. States that it is technically possible to construct welded boats 6 m. long from 3 mm. aluminum sheets. Weight of such a boat would be approximately 150 kg. RRS (7b)

Welding Thick Plates. (Das Schweissen dicker Bleche.) *Zeitschrift für Schweisstechnik,* Vol. 23, Feb. 1933, pages 37-38. Thick plates may be welded in a single operation but to do so it is necessary to have a torch of sufficient capacity. Torch should have a capacity of 150 liters/hr./mm. thickness of the plate; thus to weld a 30 mm. plate would require a torch with a capacity of 4,000 to 4,500 l./hr., and the welding rod would have to be about 10 mm. in diameter. RRS (7b)

V or X Weld. (V- oder X-Naht.) *Zeitschrift für Schweisstechnik,* Vol. 23, Feb. 1933, pages 46-47. To date X-welds have only been used for sheet thicknesses of 12 mm. or over. Discusses applicability of X-welds to sheets less than 10 mm. in thickness and states that they are suitable for short welds where both sides may be welded without undue waste of time. For longer welds, V-welds are preferable. RRS (7b)

Rail Joint Failures Reduced by Improved Welding Methods. J. W. Bragg. *Transit Journal,* Vol. 77, Apr. 1933, pages 112-113. Evolution of welding methods since 1919 is discussed. Since that time 33,733 joints were welded with only 80 failures. No failures have been reported in past 5 years when 12,994 of total welds were made. CBJ (7b)

Developments in Aircraft Welding. J. B. Johnson. *Welding News,* Vol. 3, Oct.-Dec. 1932, pages 50-52. See *Metals & Alloys,* Vol. 4, June 1933, page MA 180. Ha (7b)

New Constructions of Resistance Welding Machines (Neue Konstruktionen von Widerstandsschweissmaschinen) Hans A. Horn. *Technische Blätter der deutschen Bergwerkszeitung,* Vol. 23, Aug. 13, 1933, pages 436-438. Description of a large number of modern resistance welding machines of high capacity, spot welding machines are particularly referred to. In many cases cast body of welding machine has been replaced by welded construction. Most important result of increased transformer capacity of resistance welding machines is increase in number of welded spots/hr. Newest developments are automatic butt welding machines whose advantages are considered at length. Not only size and shape of welded cross-sections but also type of welded material and heat conditions determine welding pressure required. Steels with more than 50 kg./mm.^{2} tensile strength require higher pressure than is common (1 kg./mm.^{2}) to avoid detrimental effects of heat on structure of such steels. For these reasons automatic machines have been developed. GN (7b)

Welding Practice for Nickel-Clad Steel Plate. F. P. Huston. *Welding Engineer,* Vol. 17, Sept. 1932, pages 24-29. Usefulness of steel plates clad with Ni of 0.05 to 0.065″ thickness in construction of massive pressure vessels, storage tanks and the like where Ni forms lining is pointed out; Ni contributes additional strength, it increases ultimate tensile strength from 500 to 5000 lbs./in.^{2}. Metallic arc welding is the most advantageous method and consists mostly of a steel weld on one side and a finishing bead of Ni on the Ni-side. A special Ni electric welding wire should be used. The various types of joint are discussed and illustrated diagrammatically. Carbon arc, acetylene and atomic hydrogen welding can also be used with certain precautions. The preparation of the material and field methods of welding are described. Ha (7b)

Removing Saddle Bolts and Tightening Springs with a Gas Torch. F. L. Huggins. *Industry & Welding,* Vol. 5, June 1933, pages 18-20. In repairing driving spring bands of locomotives that have become loose an oxy-acetylene torch was applied for repair which resulted in a saving over repairing by forging. Ha (7b)

Significance of Economic Maintenance with Reference to Street Railway Tracks (Die Bedeutung der wirtschaftlichen Gleispflege für Strassenbahnen) Ph. Kremer. *Verkehrstechnik,* Vol. 50, June 20, 1933, pages 296-297. Summary of results gained during the winter 1932/33 on 38,000 rails incorporated in the Municipal tracks of the City of Frankfort on the Main. Ten rail fractures = 0.025% occurred at a distance of 2-3 m. from joints. 11 fractures or 0.104% were connected with electrically welded fish joints and there was only 1 joint failure out of 3638 (= 0.03%) joints welded according to a new method in which the resistance moment of the rail joint does not involve an abrupt change. WH (7b)

Rail Joint Welding with the Electric Arc (Die Schienenstossschweissung mit dem elektrischen Lichtbogen) H. Lotze. *Verkehrstechnik,* Vol. 50, May 5, 1933, pages 222-224. Welding methods are subdivided into 2 groups: (1) Seam welding or indirect welding, i.e., making of a continuous seam along the outer edges of the rail and utilization of special auxiliary joining means such as insertion plates, lashes, sheets, etc. (2) Direct or cross-section welding in which the whole gap is filled in with fusion metal. WH (7b)

Electrically Welded Road Bridges of Union Structural Steel (Die elektrisch geschweissten Strassenbrücken aus Union- Baustahl über die Aller bei Verden) W. Püngel & W. Lohmann. *Die Elektroschweissung,* Vol. 4, July 1933, pages 121-123. Description of welding and constructural work on the above mentioned bridges. Of particular interest are the development of the welded beam constructions used and the results of welding tests during assembly. 12% of the welds were made on the building site with special coated electrodes suitable for the steel used. 26% in weight saved as contrasted with riveted St. 37 steel construction originally projected. GN (7b)

Building up Worn Rail Joints. Stuart Plumley. *Welding Engineer,* Vol. 17, Sept. 1932, pages 40-41. Examples are illustrated and the procedure in every case described. Ha (7b)

Research in the Fields of Welding Technique (Die Forschung in der Schweissung) Przygode. *Die Wärme,* Vol. 55, Oct. 15, 1932, page 737. The latest advancements pertaining to "Linnewall," "Langmuir Arcaton," "Arcogen-Griesogen," "Konstantan," "Frama and Pintsch" methods are characterized. EF (7b)

Fusion Welding as Related to Steel Castings. T. S. Quinn. *Foundry Trade Journal,* Vol. 47, Sept. 15, 1932, pages 157-158, 164; Sept. 22, 1932, pages 167-168, 177; *Sheet Metal Industries,* Vol. 6, Dec. 1932, pages 529-531; Jan. 1933, pages 602-606. See *Metals & Alloys,* Vol. 4, Aug. 1933, page MA 260. AWM + OWE (7b)

Machine Cutting by the Oxyacetylene Process. R. F. Helmkamp. *Paper presented at the International Acetylene Association,* Philadelphia, Nov. 1932, 4 pages. Characteristics and advantages of this process, preparation of work and equipment are discussed and illustrated by examples. Ha (7b)

Design and Manufacture of Welded Steel Fabrications. H. W. Hawkins. *Journal Institution of Production Engineers,* Vol. 12, Feb. 1933, pages 59-78. Includes discussion. A general review of the methods available for making welded steel structures and machine parts. Design of welded parts, the layout of a welding shop, and inspection procedure are briefly considered. JCC (7b)

Welding of Steel Structures. G. N. Borrow & C. H. Lobban. *Journal American Welding Society,* Vol. 12, Jan. 1933, pages 32-39. Constitutes Chap. 6 of a Report published by Department of Scientific and Industrial Research, entitled "First Report of the Steel Structures Research Committee." An investigation of strengths of welded joints under present British practice. Includes a discussion of the types of welds in use, a table shows permissible stress in welded joints under various existing regulations, field tests for soundness of welded joints, and properties of welds. Part II is a report of tests on selected specimens and Part III a program of future work. TEJ (7b)

Weight and Cost of Steel Dies Reduced by Use of Gas Cutting and Welding. Everett Chapman. *Journal American Welding Society,* Vol. 12, Jan. 1933, pages 26-27. See *Metals & Alloys,* Vol. 4, Aug. 1933, page MA 260. TEJ (7b)

Preheating. Raymond Cook. *Welding News,* Vol. 3, July-Sept. 1932, pages 39-42. The importance of proper preheating in welding operations of cast Fe and non-ferrous castings is illustrated by several examples and economical methods by gas, charcoal or oil are described. Ha (7b)

Building Up and Heat Treating Rail Ends. Walter Constance. *Welding Journal,* Vol. 30, Mar. 1933, page 92. See *Metals & Alloys,* Vol. 4, Aug. 1933, page MA 259. TEJ 7b)

Pipe Welding Facts. A. E. Christen. *Welder,* Vol. 4, Feb. 1933, pages 18-25. Examples of building piping systems and pipe fittings by welding are illustrated and the characteristics of materials used point out with respect to corrosiveness, treatment and welding procedure discussed in general. Ha (7b)

Applications of Fusion Welding in Motor Car Construction as Seen in the Last Paris Automobile Show (Applications de la Soudure Autogène à la Construction Automobile d'après le Dernier Salon) R. Salelles. *Bulletin de la Société des Ingénieurs Soudeurs,* Vol. 3, Aug.-Sept.-Oct. 1932, pages 697-709. Lecture before the French Welders' Association. The trend in French motor cars is towards the construction of comfortable cars but with low power motors. This can be accomplished by light structures possible through welding. Author explains application of welding process in the chassis and body construction. FR (7b)

Welded Plate for Furnace Work. George B. Cramp. *Metal Progress,* Vol. 23, May 1933, pages 24-27. Various applications of structures welded from plate and pipe are described. Satisfactory tolerances in gas torch cutting have been obtained and such parts as water cooled rolls and furnace structures have been produced from welded plate and pipe. WLC (7b)

Maintenance Welding. Jos. C. Coyle. *Welding Engineer,* Vol. 17, Nov. 1932, page 20. Describes uses of welding in maintenance of equipment, saws, conveyors, etc. in a large plant making wooden veneers. Ha (7b)

Electric Arc Welders Join the Railroad Gang. W. W. Reddie. *Electric Journal,* Vol. 30, July 1933, pages 307-308. Tractor welder with caterpillar treads is described. CBJ (7b)

Caution on Welding Tanks with Protective Paints (Vorsicht beim Schweissen von Behältern mit Schutzanstrichen) Quint. *Die Schmelzschweissung,* Vol. 11, Sept. 1932, page 206. Gases developing from a not fully dried rust-protecting paint in the inside of a tank caused an explosion with fatal result to welder. Ha (7b)

Uses of Welding in the Construction of Refrigerating Machines. S. Sandelowsky. *Engineering Progress,* Vol. 13, Sept. 1932, pages 201-203. General discussions of applications. Welding permits the use of rolled steel instead of cast iron. Advantages are: saving of as much as 35% in weight, increased rigidity, higher resistance to wear, and greater adaptability to changes in design. RHP (7b)

Fusion Welding in Decoration of Houses (La Soudure Autogène en Ferronnerie et Ameublement d'Art) R. Salelles. *Bulletin de la Société des Ingénieurs Soudeurs,* Vol. 3, Aug.-Sept.-Oct. 1932, pages 680-691. Lecture before the French Welders' Association. Fusion welding is the best process as compared with others in this kind of work. Welds must be strong to resist high stresses during polishing. Furthermore welds must be without defects which would become apparent during acid pickling. Author shows examples of work made by Etablissements Edgar Brandt in Paris (Candlesticks, lamps, vases, clocks, bed frames, tables, book caskets, radiator covers, screens, doors, balustrades, etc.) FR (7b)

Acetylene Welding in Steel Structures (Azetylenschweissarbeit aus dem Stahlbau) H. Holler. *Forschungsarbeiten auf dem Gebiete des Schweissens und Schneidens mittels Sauerstoff und Azetylen,* Series 7, 1932, pages 12-30. See *Metals & Alloys,* Vol. 4, June 1933, page MA 180. Ha (7b)

Use of Acetylene Welding for Repairing Boilers (Anwendung der Azetylenschweissung bei der Ausbesserung von Kesseln) W. Höhnisch. *Apparatebau,* Vol. 45, Apr. 14, 1933, pages 41-42; *Die Schmelzschweissung,* Vol. 11, Dec. 1932, page 258; *Der Autogen Schweisser,* Vol. 5, Oct. 1932, pages 218-221. See *Metals & Alloys,* Vol. 4, Aug. 1933, page MA 259. Ha + GN + Kz (7b)

Welding Advances in the Fence Industry. B. Heyman. *American Machinist,* Vol. 76, Mar. 10, 1932, pages 334-337. General article on the production of welded steel fence. Largely concerned with the advantages of welding over the former caulking methods. Contains little material regarding welding processes. RHP (7b)

Welding Stresses (Spannungen beim Schweissen) E. Helfrich. *Die Wärme,* Vol. 55, Sept. 24, 1932, pages 654-660. Unequal heating of the welded objects as the main source responsible for the occurrence of welding stresses is fully dealt with. The correlation of welding stresses to temperatures and elongation are considered in special chapter. The course of welding stresses with reference to some characteristic welding operations and to the different kind of seams is theoretically and graphically dealt with. The last chapter furnishes suggestions on how to minimize or eliminate welding stresses. EF (7b)

Reinforcement of Riveted Beams by Means of Attaching Plates by Welding (Verstärkung von genieteten Trägern mittels Anschweissung von Lamellen) C. J. Hoppe. *Die Elektroschweissung,* Vol. 4, Aug. 1933, pages 154-155. Report of investigations by E. O. Patton & W. W. Schewernitzky of the Ukrainian Academy of Science, Kiew. 6 types of I-beams were tested first before having been reinforced, then after having been reinforced by welding on plates. The samples were loaded in a 500 tons MAN testing machine. The deflections in the middle of the loaded beams were measured by recording dials, the tensions with Huggenberger extensometers. Welding of the binding vault angles to the plates always increased the actual resistance moments and therefore always deemed advisable. GN (7b)

Weld Seams on Wrought Iron and Their Tensile Strength (Auf Schweisseisen geschweisste Nähte und ihre Festigkeit) C. J. Hoppe. *Die Elektroschweissung,* Vol. 4, June 1933, page 112. The results of investigations by Paton & Grebelnik carried on at the Ukrainian Academy of Science are summarized. The knowledge of the strength of weld seams on wrought Fe is of particular interest in reinforcing old bridges since it is known that the fracture of reinforced parts welded on wrought Fe does not occur in the seam but the reinforcement fails due to scaling off of the upper wrought Fe layers. In the tests described the dimensions of plates and fish plates were so chosen that fracture always occurred in the welded areas. GN (7b)

Electric Welding of Rail Shorts by Arcos Method. M. A. Frishman & N. A. Peresko. *Welding,* No. 5, 1933, pages 16-18 (In Russian). Sections of rails 2 meters long were used for railroad track by welding butted ends of their bases to a steel plate and joining the heads by welding. Physical results were not satisfactory. (7b)

Arc Welding in Small Iron Construction (Lichtbogenschweissung im Feineisenbau) J. C. Fritz. *Die Elektroschweissung,* Vol. 4, June 1933, pages 110-111. The author first discusses the reasons why arc welding is not yet used to a large extent in small iron construction, such as increased costs due to the necessary smoothing of the weld seams, expensiveness of coated electrodes and large size welding machinery, etc. The successful and economic use of welding in this field in recent times is then considered pointing out the advantages over other methods of joining small iron parts. As examples are cited doors, gates, staircases, wardrobes, window frames, etc. GN (7b)

Welding Aluminum. I & II. Werner Froelich. *Canadian Chemistry & Metallurgy,* Vol. 17, Mar. 1933, pages 56, 58; Apr. 1933, pages 79-80. An Al weld should possess strength, ductility and corrosion-resistance. These properties are very closely related to each other. Nine essential characteristics of Al that determine its welding properties and the success of the welding operations are outlined. The flux mixtures employed are important. A number are listed and their application outlined. WHB (7b)

Arc-Welded Jigs, Fixtures and Gages. L. E. Fuller. *Machinery,* Vol. 38, July 1932, pages 811-813. Arc-welded tools should be normalized at about 1300° F. Practically all of article deals with design. RHP (7b)

Alumino Thermal Rail Welding (Aluminothermische Schienenschweissung in Gleisbildern) A. Fuchs. *Verkehrstechnik,* Vol. 49, May 15, 1932, pages 266-268. The difficulties involved in the alumino thermal welding of rails are discussed critically. Welding with a 10 mm. filler plate and complicated welding performances on some some special rail constructions are dealt with. The last chapter furnishes instructions on the actual accomplishment with emphasis on precautions to be observed. WH (7b)

Welding Practice in Manufacturing Steel Furniture (Die Schweisstechnik bei der Herstellung von Stahlmöbeln) A. Finkelstein. *Werkstattstechnik,* Vol. 27, Jan. 15, 1933, pages 29-31. A short preview considers the requirements of the raw material: sheets and strip. Without the utmost standardization of most parts of this furniture (mostly office equipment) competition against wooden furniture will hardly be withstood. Acetylene and spot welding are used. Examples of various applications are illustrated and some hints for special designs sketched. RV (7b)

Weld Test Device (Ein Schweissprüfgerät) H. Flamm. *Werkstattstechnik,* Vol. 27, Jan. 15, 1933, pages 39-40. The principle is explained and illustrated. The instrument is used for testing electric welding rods against each other or their steadiness in continuous operation. If the quality of the rod is constantly the same and the welding machinery checked, it might be applied for control of the dependability of the welders. Conclusions as to the properties of the weld can be drawn from the registrated record and poor welds may be scrapped accordingly. The possibility of a remote control of any welding job carried out at any place in the plant is shown by switching the instrument in the respective circuit. RV (7b)

Lead Welding. A. J. T. Eyles. *Electrical Review,* Vol. 112, May 5, 1933, page 628. Notes on materials and procedure for oxy-acetylene Pb burning. Surfaces must be scrupulously clean. Excess of oxygen in flame should be avoided. Neutral flame gives best speed and economy. Welding rods and bars should not be kept in a damp or dirty atmosphere. Rods and bars cast a short time before being used are preferable. Ordinary Pb should not be used for repair of Pb containing Sb. Cable joints made by modern Pb welding do not corrode by electrolysis as may happen when made by wiping with solder. MS (7b)

The Functions of Protective Coatings in Arc Welding. G. E. Durham & J. B. Austin. *Industry & Welding,* Vol. 5, June 1933, pages 12-15, 22-28. The use of coated electrodes in arc-welding is advisable as the high temperature of the arc favors the absorption of O and N to avoid which would result in very slow welding rates with bare electrodes. The metal is protected during its transfer from electrode to material either by forming a protective slag or creating a shield of reducing gases around the arc; both methods can be combined. Practical applications of these principles and mechanical and metallurgical conditions and properties of such welds are described. Ha (7b)

Researches in Arc Welding. G. E. Doan & J. L. Meyer. *Journal American Welding Society,* Vol. 11, Nov. 1932, pages 26-28; *Electrical Engineering,* Vol. 51, Sept. 1932, pages 624-627. See *Metals & Alloys,* Vol. 4, July 1933, page MA 220. Ha + TEJ (7b)

Metal Deposition in Electric Arc Welding. G. E. Doan & J. Murray Weed. *Electrical Engineering,* Vol. 51, Dec. 1932, pages 852-854. See *Metals & Alloys,* Vol. 4, June 1933, page MA 181. Ha (7b)

Strength of Welds High in Oxygen. Hans Diergarten. *Metal Progress,* Vol. 23, May 1933, pages 45-47, 60. Describes experiments with tube welding in which the O_2- acetylene ratio was varied between 0.9 and 2.1. It was found and shown graphically that the O_2 content of the weld metal increased with the O_2 ratio of the flame but that the strength of the weld was unaffected. With O_2-acetylene below 0.9 appreciable carburizing effects were noted. WLC (7b)

The Construction of an All-Welded Hoist. W. H. Denlinger. *General Electric Review,* Vol. 36, June 1933, pages 269-270. Electrical friction hoist was fabricated from structural steel shapes by means of gas cutting and arc welding. CBJ (7b)

Tubes Welded to Spheres. A. F. Burstall. *Metal Progress,* Vol. 23, Feb. 1933, pages 48-49. Difficulties of forming joints at tubular intersections are described. The author has patented a method whereby a sphere is inserted at the intersection and each member joined at right angles to its axis, the line of contact being a circle. Each tube may thus be cut off square, the cheapest way. Sidewise eccentricity is avoided and assembly expedited. The spheres are made by pressing flat plates into hemispheres and welding together in an ordinary resistance machine with hemispherical chucks. A summary of comparative costs of this and other methods is presented in a table. Greater strength, less weight and perfect surface with lower cost are claimed for this construction. WLC (7b)

Review of the Foreign Literature on Fusion Welding (Revue de la Presse Etrangère de la Soudure Autogène) J. Brillie. *Bulletin de la Société des Ingénieurs Soudeurs,* Vol. 3, May-July 1932, pages 628-642. Lecture before the "Sociétë des Ingénieurs Soudeurs." Author divides material as follows: Electric welding, oxy acetylene welding and resistance welding. Miscellaneous works. FR (7b)

Welded Repairs. C. W. Brett. *Electrical Review,* Vol. 113, Aug. 11, 1933, page 182. Describes application of welding for repair of condenser casings, turbo-generators, steam-boilers, internal-combustion engines, and other equipment in electric plants. MS (7b)

Fusion Welding of Stainless Steels (La soudure autogène des aciers inoxydables) A. Boutte. *Revue du Nickel,* Vol. 3, July 1932, pages 98-101. Describes methods for successful welding of stainless steels. AH (7b)

Butt Welding. N. Bournes. *Mechanical World & Engineering Record,* Vol. 91, June 17, 1932, pages 577-578. A time-study comparison of electrical and oxyacetylene welding, showing a saving in electric welding. Kz (7b)

Arc Welding Introduces New Methods in Machine Design. Everett Chapman. *Machinery,* N. Y., Vol. 39, Dec. 1932, pages 241-246. Chiefly a description of the process of calculating stresses in, and constructing a 500 ton arc welded press frame. Suggests using a celluloid model which when subjected to strain in polarized light shows stressed parts by colored interference bands. Discusses advantages of welded construction. RHP (7b)

Fusion Welding of Window Gratings (Autogen geschweisste Fenstergitter) O. Rothlin. *Zeitschrift für Schweisstechnik,* Vol. 23, Apr. 1933, pages 105-106. Design data and specifications for welds. RRS (7b)

Structural Welding. G. N. Robinson. *Welding Engineer,* Vol. 17, Nov. 1932, pages 21-22. Structural towers of 90 ft. height were welded, details are described. Structures serve as supports for coal conveyors, transmission lines, etc., of Victor American Fuel Co. in southern Colorado. Ha (7b)

Direct Current Carbon Arc Welding and Magnetic Deflection of the Arc (Gleichstrom Kohlelichtbogenschweissung mit besonderer Berücksichtigung magnetischer Ablenkungen des Lichbogens) K. Reiter. Doktor Ing. dissertation. Technische Hochschule, Aachen, 1931. 36 pages, 25 illustrations. Deals with behavior of an arc made to rotate by means of a magnetic field. No quantitative tests were made on the quality of the welds. HWG (7b)

Welding in Ship-Building (Schweissen im Schiffbau) Lottmann. *Schiffbau, Schiffahrt und Hafenbau,* Vol. 33, July 1, 1932, pages 199-206; July 15, 1932, pages 215-222; Aug. 1, 1932, pages 232-238; Aug. 15, 1932, pages 251-258. (Also available as reprint, 32 pages, 58 illustrations, price 3.50 RM, Deutsche Verlagswerke, Strauss, Vetter & Co., Berlin.) Survey is treated under the following heads: (I) Various welding methods, fundamental types of seams, strength of V and X-seams, significance of yield point, closed lapped corner joint, reliability of welds under bending and buckling stresses. (II) Shrinkage and shrinkage stresses and their consideration in arc-welding. Reasons for the occurrence and magnitude of shrinkages, experimental shrinkage data, internal stresses, rigid and imperfect clamping, hammering, shrinkage on automatic welding, some practical examples for taking into account shrinkage, rules for accounting for shrinkage in arc-welding. (III) Special designs, structural peculiarities, butts and seams of the hull, lashes, built-up profiles and their arrangement, rolled profiles, joggle jointing, welding in conjunction with riveting. (IV) Erection; single members, methods of assembling. (V) Economy. Comparison between a riveted and welded 875 ton ship (Norderney). WH (7b)

Welding Practice in Pump and Compressor Construction (Die Schweisstechnik im Pumpen- und Kompressorenbau) St. Patkay. *Werkstattstechnik,* Vol. 27, Jan. 15, 1933, pages 21-23. The changes effected by the development of arc welding at the Klein, Schanzlin & Becker Co. which specializes in pump and compressor construction are discussed. Many instances are illustrated. RV (7b)

Arc Welding in Ship Building (Die Lichtbogenschweissung im Schiffbau) Küchler. *Schiffbau, Schiffahrt und Hafenbau,* Vol. 34, Jan. 1, 1933, pages 8-10; Feb. 1, 1933, pages 39-43; Mar. 15, 1933, pages 109-112; Apr. 1, 1933, pages 129-132. This supplement to a previous paper of Lottmann considers (1) the general principle of welding and the different welding methods with emphasis on their applicability to ship building, (2) kind of current and means of their generation, (3) evolution and present state of the electrode problem, (4) testing methods for welds and (5) ship welders and their training. WH (7b)

Steel Barrels Manufactured by Electric Resistance Welding. M. L. Leckman. *Iron Age,* Vol. 129, May 12, 1932, pages 1056-1057, adv. sec. page 20. Electric resistance welding is being used for welding steel barrels by use of equipment developed by Federal Machine & Welder Co. For weld metal sheet stock instead of filler rod electrode metal is used. Welding heat is generated by the resistance of steel to passage of low-voltage high amperage alternating current. VSP (7b)

Fusion Welding in Russia (Le Développement de la Soudure Autogène en Russie) R. Meslier. *Revue de la Soudure Autogene,* Vol. 24, Sept. 1932, pages 2598-2599. Article discusses difficulties which have arisen in Russia and steps taken to improve conditions under the second 5 year plan. FR (7b)

Welding of Everdur (Das Schweissen von Everdur) H. A. Horn & K. Tewes. *Die Schmelzschweissung,* Vol. 11, Sept. 1932, pages 196-200. Everdur is a non-ferrous alloy of 96% Cu, 3% Si and 1% Mn. The characteristic properties of both Cu and Everdur are:

	Copper	Everdur
Specific gravity	8.93	8.46
Melting Point, °C.	1083	1019
Heat conductivity, cal./°C./cm./sec.	0.90	0.078
Tensile strength, annealed, kg./mm.^{2}	21.0	34.5
Tensile strength, hammered cold	24.0	48.0
Elongation, %	38	55-71
Color	Salmon red	bronze
Corrosion resistance	good	mostly better than Cu
Weldability up to 5 mm.	good	very good
Weldability more than 5 mm.	difficult	———

The better elongation makes Everdur particularly suitable for pressure tanks, and its lesser heat conductivity accounts for better welding conditions. The strength of welded seams amounted to 72-100% of the parent metal for length of seams up to 600 mm. The elongation of the weld was an average of 48.1% at a tensile strength of 36.7 kg./mm.^{2} The tests show that with a properly adjusted welding flame and proper after-treatment (hammering) the weld can be fully equivalent to the original material. The weld must be made quickly with a flame with about 10% excess of 0 and hammering of the warm weld. Ha (7b)

Welded Metal Structures (La Charpente Métallique Soudée) M. A. Gaelzer. *Bulletin de la Société des Ingénieurs Soudeurs,* Vol. 3, Aug.-Sept.-Oct. 1932, pages 655-679. Lecture before French Welders' Association. 1st Part: Discussion of the work of the 1st Convention of the Association Internationale des Ponts et Charpentes. Dr. Kommerell read a paper dealing with use of welding in overhead structures. Possibility of strengthening old bridges through welding is pointed out. Small diameter electrodes are advocated. The welding process requires new rolled sections. Through welding a 3-20% weight saving over riveting can be obtained. Effects of shrinkage in weld are largely discussed by previous authors and means of preventing defects due to shrinkage are given. Prof. Ros made comparative tests on electric and fusion welds and concludes that both give comparable results. Dr. Dornen studied shrinkage to which he does not attach great importance. Moon, Bryla and Caldwell advocate thin electrodes. Prof. Campus points out superiority of butt welds. Lebrun explains a method permitting control welds through gamma rays. Prof. Kayser thinks that structures partially riveted and partially welded are satisfactory but M. Dustin has opposite opinion. Summarizing data of the numerous papers, the author shows the trend towards the use of thin coated electrodes and simplification of processes, toward the ideas that shrinkage is not a great disadvantage, that welders need correct training and that methods of controlling welds must be largely resorted to. Part 2. The author gives examples, with illustrations, of the use of welding in bridges and overhead structures. FR (7b)

Fusion Welding and the Foundry (La Soudure Autogène et la Fonderie) R. Granjon. *Revue de la Soudure Autogene,* Vol. 24, Sept. 1932, pages 2604-2605. Paper read before World Foundry Convention. Paris Sept. 1932. Most of foundrymen know the fusion welding through its failures and this is reason foundrymen have paid little attention to it. New processes however (oxyacetylene welding, arc welding, resistance-welding, atomic hydrogen welding) have developed considerably. Author reviews ways in which welding can help foundry. (1) Removing defects in order to reclaim imperfect castings which, after such a treatment, are quite satisfactory. (2) Reclaiming castings broken during service. (3) Construction of structures made by welding cast parts together. (4) Welding layers of metal having special properties on castings: This process is already commonly used for reclaiming worn parts but it can be directly applied to new construction for instance for covering a gray cast Fe casting wth hard white cast Fe. FR (7b)

General Welding. A. L. Cummings. *Inspection,* Vol. 4, Apr. 1933, pages 4-33. Paper read at a meeting of the Institution of Engineering Inspection at Darlington. Résumé of the various types of welding as: Smith's fire weld, water gas welding, autogenous gas welding (high and low pressure system), electric welding (carbon-arc, metallic-arc, resistance, cyc.-arc, percussion), thermit welding, and atomic hydrogen process. Dealing in detail with the metallic-arc welding the physical limitations in attaining an ideal weld are examined from the metallurgical point of view. Considered are the effect (1) on the structure and (2) upon the volume of the steel. Four main types of electrodes are discussed: (1) the quasi-arc type, (2) the flux coated, and (3) the dipped electrode, and (4) the bare wire. The importance of the design of welded joints is stressed and practical examples are discussed. Dealing with the welding of castings, difficulties and problems arising from the use of different kinds of metals and the design of castings are discussed. The various advantages of welded pieces as substitutes for castings are summarized. Precautions necessary in welding of Staybrite and heat resisting steels, of Al and Al alloys, Cu, brass, and bronze are discussed. Dealing with testing and inspection of welds the magnetic, electrical, resistance, tensile, torsion, bend, Izod, hardness, fatigue and X-Ray tests as well as the weld test meters and the Stethoscope test are discussed. Kz (7b)

Comparative Optical Investigation of Cutting Nozzles (Vergleichender optische Untersuchung von Schneiddüsen) H. Malz & H. von Conradi. *Azetylen in Wissenschaft & Industrie,* Vol. 35, Nov. 1932, pages 161-165. See *Metals & Alloys,* Vol. 4, June 1933, page MA 181. WH (7b)

Testing of Welding Torches for Low Pressure Acetylene (Das Prüfen von Schweissbrennern für Niederdruckazetylen) K. Pöttgen. *Azetylen in Wissenschaft & Industrie,* Vol. 35, Feb. 1932, pages 17-20. Discussion pages 20-22. See *Metals & Alloys,* Vol. 3, Dec. 1932, page MA 351. WH (7b)

Welded Barges. G. G. Holbrook. *Marine Engineering & Shipping Age,* Vol. 37, Sept. 1932, pages 399-402. See "Welded Barge Construction at Federal Ship-building and Dry Dock Company," *Metals & Alloys,* Vol. 4, Jan. 1933, page MA 12. EF (7b)

All-Electric Arc-Welded Steel Penstock. Clayton M. Allen. *Electric Light & Power,* Vol. 10, Dec. 1932, pages 14-17, 19; *Electrical West,* Vol. 70, Mar. 1, 1933, pages 84-87. Paper read before the Los Angeles Section of the American Welding Society, Sept. 22, 1932. See *Metals & Alloys,* Vol. 4, Oct. 1933, page MA 322. MS (7b)

Electric Welding in Railroad Repair (Die elektrische Schweissung im Eisenbahnausbesserungsbetrieb) Titscher. *Die Elektroschweissung,* Vol. 4, Aug. 1933, pages 146-148. Considers at length installation and arrangement of welding units in a railroad repair shop. Advantages derived from electric welding are discussed. Illustrations show welded railroad parts. GN (7b)

Gas Cutting and Its Utilization for Structural Work (Das Sauerstoffbrennschneiden und seine Einordnung in den Fertigbau) J. Titscher. *Der Autogen Schweisser,* Vol. 5, Jan. 1933, pages 1-4. Pointing out importance of gas cutting in the manufacturing process, metallurgical effects caused by the different cutting methods on various steels are compared. Treatment of the material before, or after gas cutting and the finishing process are dealt with. Kz (7b)

Arc-Welding Large Steel Pipe in Japan. Maurice Taylor. *Machinery,* Vol. 38, Aug. 1932, pages 889-890. Welding process used in "Electronic Tornado" process developed by Lincoln Electric Co. Describes methods. RHP (7b)

Carbon Dioxide as Flame Preventer in Welding. Floyd Swindell. *Oil Weekly,* Vol. 70, July 3, 1933, page 24. Welding of tanks and other equipment used in storing and transporting petroleum products is dealt with. Kz (7b)

Welding Wires for the Acetylene Welding of Steel (Ueber Schweissdrähte für die Azetylenschweissung von Stahl) E. Streb. *Azetylen in Wissenschaft und Industrie,* Vol. 35, Mar. 1932, pages 36-40; Apr. 1932, pages 55-60. See *Metals & Alloys,* Vol. 4, Feb. 1933, page MA 40. WH (7b)

The Radiographic Examination of Welds. R. A. Stephen. *Sheet Metal Industries,* Vol. 6, Nov. 1932, pages 451-454; *Welding Journal,* Vol. 29, Nov. 1932, pages 331-336. See *Metals & Alloys,* Vol. 4, Aug. 1933, page MA 260. TEJ + AWM (7b)

Repair Welding of a Formerly Wholly Welded Copper Locomotive Fire Box (Reparaturschweissung einer ehemals ganz geschweissten kupfernen Lokomotiv-Feuerbüchse) H. Specht. *Die Schmelzschweissung,* Vol. 11, Sept. 1932, pages 203-204. The insertion of a new part for the fire tube ends by welding is described in detail. The part had become useless due to repeated replacing of fire tubes. Ha (7b)

Weld Stresses (Ueber spannungen beim Schweissen) A. Sonderegger. *Zeitschrift für Schweisstechnik,* Vol. 23, Apr. 1933, pages 94-101. Tests on angle iron electrically welded at one point. Develops formulas for: 1. sudden cooling; 2. heavy bead; 3. with the bead thin as compared with the sheet thickness; and 4 as in 3 but with preheated material. RRS (7b)

Determination of the Quality of Electric Welds on Finished Articles by Means of Drilling. S. K. Zvegintzev. *Welding,* No. 5, 1933, pages 7-9 (In Russian). Drilling of seams with a drill having a greater diameter than the width of seams and etching with Heyn's reagent is recommended in preference to milling and etching. (7b)

Arc Welding Provides Economical Means for Steel Car Repair. William H. Zorn. *Steel,* Vol. 91, Sept. 12, 1932, pages 23-24, 26, 32, 34. Abstract of paper awarded 6th prize in arc welding contest held by Lincoln Elec. Co., Cleveland. Author describes rebuilding of 25 old gondola and hopper cars using the old chasses on which new steel bodies, center and side sills, and gear housings were arc welded. Details of assembly and cost analyses are given. Author recommends arc welding for manufacture of steel cars as offering a superior product at lower cost. JN (7b)

Shrinkage Stresses in the Weld Seam and Their Effect on the Durability of Welded Constructions (Die Schrumpfspannungen in der Schweissnaht und ihr Einfluss auf die Haltbarkeit geschweisster Konstruktionen) Hansjoachim Ziem. *Glasers Annalen,* Vol. 113, July 15, 1933, pages 13-14. Experience shows that welds sustain even very high service loads when the initial loads in the seams are kept low enough to exclude danger of fracture. Author discusses these conditions verifying the fact that shrinkage stresses do not impair the durability of welded constructions when the seams are properly made. The danger still handicapping the designer of welded construction can thus be eliminated. GN 7b)

Lead Burning or Welding. Robert L. Ziegfield. *Sheet Metal Industries,* Vol. 6, Feb. 1933, pages 673-674; Mar. 1933, page 746. **Lead Welding Procedure and Applications.** *Welding Engineer,* Vol. 17, Oct. 1932, pages 34-37. Paper, Autumn meeting, American Welding Society. See *Metals & Alloys,* Vol. 4, July 1933, page MA 220. AWM + Ha (7b)

Carburizing Test for Quality of Welded Joints. Correspondence from Werner Zieler. *Metal Progress,* Vol. 22, Sept. 1932, pages 50-51. McQuaid-Ehn carburizing test has been successfully applied to the testing of the uniformity of weld metal. Under an atmosphere of H, He, or CO, a normal structure is obtained. On welding under CO_2 or O_2 abnormal structure is obtained. A recently improved method is to coat the rod with a suitable coating to provide proper atmosphere and a slag to exclude the atmosphere from the weld. Micrographs show welds made with good and bad coatings which gave normal and abnormal structure respectively. WLC (7b)

Old and New Facts on A.C. Welding (Altes und Neues von der Wechselstromschweissung) O. Wundram. *Die Elektroschweissung,* Vol. 4, May 1933, pages 81-84. Detailed discussion of advantages and disadvantages of a.c. welding with special regard to the recent developments in up-to-date welding machinery. It is pointed out that disadvantages as poor power factor, too high terminal voltage, single phase loading, dangerous contact voltage can be avoided economically. A.c. welding is chiefly a question of the use of suitable electrodes. GN (7b)

Welding and Cutting (Schweissen und Schneiden in Wechselbeziehung zu Metallurgie und Betrieb) Joh. Titscher. *Der Autogen Schweisser,* Vol. 6, May 1933, pages 53-57; June 1933, pages 71-73; July 1933, pages 89-90. Discussion of various kinds of failures in construction parts and their causes. Special attention is paid to fatigue failures and the distribution of stress lines in machined and welded parts are dealt with. Changes in structure and hardness of various steels, caused by welding and heat treatment are discussed as well as characteristics of welding rods. There is no universal welding rod suitable for all welding jobs on brass. According to the kind of welding and the characteristics expected, one of three welding rods has to be chosen. Light metal welding is touched upon. Dealing with the welding of cast iron, the influence of additions of Si, Ni, Cr, and Al to welding rods on the weld are discussed. Kz (7b)

Calculation of the Weight of Welding Metal (Die Berechnung des Gewichtes des Schweissmetalles) D. Seferian. *Die Schmelzschweissung,* Vol. 11, Dec. 1932, page 276; from *Revue de la Soudure Autogene,* Jan. 1932, pages 1919-1922; Mar. 1933, page 1962. The required weight of the added metal can be calculated from the formula $P = C \times c^2$ where c is the thickness of the sheet. The following table gives the values for C:

Material	manner of preparation of the edges	C
Steel	straight butt c below 5 mm.	12
	45° angle, c $>$ 5 mm.	10
	40° angle	9
	35° angle	8
	30° angle	7
Copper	straight butt, thin sheets	18
	45° angle. c $>$ 4 mm.	14
Brass	straight butt, thin sheets	16.5
	45° angle, c $>$ 4 mm.	13
Al	straight butt, thin sheets	6
	45° angle, e $>$ 4 mm.	4.5

Ha (7b)

Resistance Welding of Non-Ferrous Metals (Die Widerstandschweissung der Nichteisenmetalle) M. v. Schwarz & F. Goldman. *Zeitschrift für Metallkunde,* Vol. 25, June 1933, pages 142-143. General discussion of methods, of application, and of the influence of welding on age-hardening of Al alloys. RFM (7b)

Welding in Shipbuilding. A. T. Wall. *Journal of Commerce (Shipbuilding and Engineering Edition),* Jan. 26, 1933, page 3. General discussion of advent of welding in shipbuilding deals with both electric and oxy-acetylene welding processes and considers effect that such processes have on large steel structures in producing distortion and locked-up stresses and how those may be avoided by careful and proper design of structure and order and arrangement of welding. Consideration is also given to use of welding in warships, to training of welders, to chief requirements of welding, to its advantages to shipowners, to its effect on ship design, and to possibilities to be expected from its application. JWD (7b)

Application of Welding in Passenger and Freight Car Construction of the German Railroad Company (Die Anwendung des Schweissens im Waggonbau der deutschen Reichsbahn) G. Wiens. *Werkstattstechnik,* Vol. 27, Jan. 15, 1933, pages 24-26. The first stage of the experiments was started in 1929. After the first success, an order on about 20 cars of various types was given to several companies, each of which had to try it in its own way to build the cars as much as possible by welding from the chassis to the roof. Savings in weight amount to 15-30% without diminishing safety. Some parts that are cheaper when manufactured by riveting are mentioned. Examples of single joints and some complete parts of the construction are illustrated. RV (7b)

New Methods in Building Large Butt Welding Machines (Neue Wege beim Bau grosser Stumpfschweissmaschinen) H. Wilbert. *Die Elektroschweissung,* Vol. 4, Aug. 1933, pages 141-143. Following a survey on manually, semi-automatically and fully automatically operated butt welding machines a new type is described in which the adjustment to the actual conditions of operation is facilitated. The new machines are welded and combine low weight with highest strength and resistance to fracture against occurring shock-wise loading. The method of operation is considered at length. GN (7b)

Rigidity of Long Rail Track. S. Wildt. *Railway Engineer,* Vol. 53, Apr. 1932, pages 128-131. This highly specialized paper based on many formulae points out an "ingenious method of enabling rail joints to be eliminated" mainly based on the insertion of ballast rails and the utilization of welding for which the following advantages are claimed: (1) reduced maintenance expenses of the track and the rolling stock, (2) reduced resistance to tractive effort and (3) increased life of the rails. WH (7b)

Electric Welding of Railway Bridges on the London North-East Railroad (Elektrische Schweissung bei Eisenbahnbrücken auf der London-Nord-Ostbahn) K. Rothe. *Organ für die Fortschritte des Eisenbahnwesens,* Vol. 88, Jan. 15, 1933, page 43. Detailed description of the peculiar conditions under which the renovation of 2 bridges had to be carried out and the successful solution with electric welding. Since 40% of the welding operations were performed in the shop only 60% field work was required. EF (7b)

Meeting Some of the Problems of the Pressure Vessel User. T. McL. Jasper, O. E. Andrus & L. J. Larson. *Refiner & Natural Gasoline Manufacturer,* Vol. 12, May 1933, pages 174-179. Requirements of pressure vessels and the problem of meeting these service conditions by the A. O. Smith Corp. are described in a very general manner. Numerous illustrations show some of typical structures fabricated for oil industry and equipment used in processing. It is pointed out that the design is the all important factor. Tests show conclusively the value of theories in pressure vessel design as well as prove the ability of the fabrication to produce products of desired safety. Use of solid stainless steel vessels has proven uneconomical for either high pressures or temperatures. Under severe corrosive or oxidizing conditions special heat or corrosion resisting liners are used. Arc-welding has many valuable features in fabrication of vessels. 18-8 Cr-Ni steel liners with C content below 0.20% show less signs of intercrystalline cracking after years of service than same composition with 0.20% C or more. See also "Welding Progress at the A. O. Smith Plant," *Metals & Alloys,* Vol. 4, Mar. 1933, page MA 73. WAT (7b)

Use of Liquid Ammonia Gas Instead of Hydrogen for Fusion Welding (L'Emploi du Gaz Ammoniac Liquéfié à la Place de l'Hydrogène pour la Soudure Autogène) F. Muhlert. *Chaleur et Industrie,* Vol. 13, Sept. 1932, pages 545-546. It would not appear logical to decompose NH_3 after having obtained it by a complicated synthesis. However, the process is quite logical and economical in some cases, for instance for small plants. This process was originated at the "du Pont de Nemours Powder Company." According to the calculations of Berliner and Burke, a tank of NH_3 is equivalent to 17 tanks of H so that a saving of 50% of the hydrogen price can be reached if NH_3 is substituted for H. The decomposition of NH_3 is a simple cracking obtained in a small electrical furnace containing a catalyst (ferric oxide). A mixture of 25% N and 75% H is obtained, of course: the temperature of the flame when this mixture is burned is somewhat lower than that of pure H. FR (7b)

The Tube as a Construction Element in Conjunction with Welding. (Das Rohr als Konstruktionselement in Verbindung mit Schweissung.) *Zeitschrift für Schweisstechnik,* Vol. 23, May 1933, pages 136-139. Describes patented process for joining tubes to t-sections by welding, as well as to other sections in aircraft construction and in the making of welded fittings such as elbows, etc RRS (7b)

New Applications of Welding Torch in Machine Construction. (Neue Anwendungen des Schweissbrenner in Maschinenbau.) *Zeitschrift für Schweisstechnik,* Vol. 23, May 1933, pages 139-141. 200 to 400 l. of oxygen are required for cutting out 1 kg. of iron. Gives a brief description of the method of forming machine parts by means of the oxy-acetylene cutting torch RRS (7b)

Metallurgy of Fusion Welding of Iron (Zur Metallurgie der Schmelzschweissung des Eisens) W. Kleinefenn. *Die Giesserei,* Vol. 20, Mar. 1933, page 113. A very low (0.02%) C steel, a normal unalloyed and a Ni-alloyed welding wire were used for experiments to determine absorption and effects of O and N when welded (1) with the oxy-acetylene flame, (2) with d.c. and bare electrode, (3) with d.c. and coated electrode, and (4) with a.c. and coated electrode. The greatest absorption of O and N was observed for arc-welding with bare electrode, O_2 up to 0.24%, N_2 up to 0.16%. The Ni alloy shows a very low N content for oxy-acetylene and arc-welding. Normalizing (annealing above A_3) causes recrystallization with the usual effects on tensile strength, elongation, reduction and hardness, but exerts in all electrical welding methods a very harmful influence on the notch-toughness if the O content exceeds greatly the solubility limit of O in α-iron at room temperature. The use of Ni alloyed wires for oxy-acetylene welding and Ni-alloyed electrodes for arc-welding with coating containing a strong deoxidation agent gives very satisfactory results with respect to aging which is particularly important in boiler welding. The increase of hardening which was observed in annealing for 12 days seems to be due to N in the electric methods while C also plays a part in oxy-acetylene welding. The hardening effect was very small for an alloy with 3% Ni. Welding with d.c. and a.c. was entirely equivalent if coated electrodes were used. Ha (7b)

Constructional Tests on Mild Steel Rolled Sections with Electrically Welded Joints. B. P. Haigh. *Transactions Institute of Naval Architects,* Vol. 75, 1933, pages 59-68, discussion, pages 77-96; *Engineer,* Vol. 155, Apr. 21, 1933, pages 394-397. A description of tests carried out on electric welded joints of various types in which the tested joints were pulled in such a manner that the sections were subjected to a bending moment, tension, and shear, and where the test joints showed little visible sign of injury, although the mild steel sections were severely bent or buckled. LFM + JWD (7b)

Right or Left Hand Welding (Rechts- oder Linksschweissung) F. Hermann. *Forschungsarbeiten auf dem Gebiete des Schweissens und Schneidens mittels Sauerstoff und Azetylen,* Series 8, 1933, pages 18-22; *Autogene Metallbearbeitung,* Vol. 26, May 15, 1933, pages 145-150. The respective advantages of right hand (retrograde) or left hand (progressing) welding, that is, flame preceding or following the wire in the progress of the weld, are discussed; the right-hand or retrograde method is given preference where economy and high quality are first consideration, especially in boiler welding; tables showing the increased length of weld and reduced acetylene consumption are given. A practical characteristic number, the product of output in m./hr. by thickness of sheet in mm. is developed which was in average 20 for right-hand and 13.3 for left-hand welding. Also metallurgical advantages are obtained by right-hand welding as the position of the torch and the greater welding velocity permit letting the flame play only a short time on the fused material with a consequent smaller loss by burned material and Si, Mn and C; structure is denser and purer because of the active agitation of the wire which brings impurities to the surface where they are removed by the flame. Rust-proof steels, Ni and Monel metal should always be welded by the right-hand method. Examples of different welded products are illustrated. Ha (7b)

The Use of Electric Arc Welding in Warship Construction. C. S. Lillicrap. *Transactions Institute of Naval Architects,* Vol. 75, 1933, pages 45-58; discussion, pages 77-96; *Welder,* Vol. 4, May 1933, pages 16-19; *Engineer,* Vol. 155, Apr. 21, 1933, pages 396-397, 409-410. In discussing electric welding as applied to warship construction consideration is given to electrodes, the parent metal, preparation of the work, and welding policy and procedure. Ha + LFM + JWD (7b)

Design Your Welded Piping. F. S. G. Williams. *Journal American Welding Society,* Vol. 12, Jan. 1933, pages 10-13. Paper presented at Joint Meeting of New York Section, American Welding Society and the Petroleum and Power Division, American Society of Mechanical Engineers, Dec. 13, 1932. Stresses importance of using properly designed seamless pipe fittings and shows that it is possible to effect decided operating economies through use of seamless welding elbows rather than miter welds or screwed fittings.. TEJ (7b)

Details in Welding of Austro-Daimler High-speed-motorcars (Schweisstechnische Details vom Austro-Daimler Schnelltriebwagen) V. Walter. *Der Autogen Schweisser,* Vol. 6, Feb. 1933, pages 13-17. Illustrated discussion of details of fusion welding in construction and assembly of the Austro-Daimler motor railway car. Kz (7b)

Design and Construction of an Arc Welded Naval Auxiliary Vessel. Homer N. Wallin & Henry A. Schade. *Journal American Welding Society,* Vol. 11, Dec. 1932, pages 5-7. **Arc Welded Naval Auxiliary Vessel.** *Marine Engineering & Shipping Age,* Vol. 37, Oct. 1932, pages 436-439. See *Metals & Alloys,* Vol. 4, July 1933, page MA 220. TEJ + Kz (7b)

Alternating Current Welding Arc (Der Wechselstromschweisslichtbogen) Artur Waclawik. *Die Elektroschweissung,* Vol. 4, June 1933, page 114. Theoretical considerations. The author points out that in order to attain continuity of the arc the ohmic resistance in the welding circuit should be as low as possible. GN (7b)

Progress in the Field of Mechanical Gas Cutting (Fortschritte auf dem Gebiet des maschinellen Sauerstoffbrennschneidens) Alfred Vogel. *Der Autogen Schweisser,* Vol. 6, Feb. 1933, pages 21-24. Brief review and discussion of new gas cutting machines and their application. Kz (7b)

Fillet Sizes for Arc-Welded Construction. Robert Tweedside. *Machinery,* N. Y., Vol. 39, Sept. 1932, pages 57-58; Dec. 1932, page 283. Includes discussion. Brief article including calculations, a table giving safe loads on arc-welded triangular fillets, hand driven rivets and unfinished bolts. RHP (7b)

Great Lake Engineering Builds a Welded Cruiser. Dwight True. *Marine Engineering & Shipping Age,* Vol. 38, Apr. 1933, pages 135-136. The different types of welding employed are illustrated and discussed. To speed the work, provide stronger welds and welds more resistant to corrosion the shielded-arc process was used. Kz (7b)

Problems in Machine Welding. J. L. Anderson. *Welding Engineer,* Vol. 17, Sept. 1932, pages 30-32, 39. See "Machine Welding-Problems in Design and Operations," *Metals & Alloys,* Vol. 4, Apr. 1933, page MA 118. Ha (7b)

Fabricating Thin Sheet Monel Metal. *Sheet Metal Worker,* Vol. 23, July 1932, pages 337, 348. Practical hints for welding this material are given. Brazo flux and bevelling sheets thicker than 1/16" are recommended. Ha (7b)

The Repairing of Iron Castings (La Reparation des Pieces en Fonderie de Fonte) Fr. Simorre. *Revue de Fonderie Moderne,* Vol. 26, Nov. 10, 1932, pages 411-415. Repairing of castings can be effected by electric welding, and gas welding, the latter method is the most general. Several examples are described which illustrate processes and reason why particular method has been applied. Ha (7b)

Automatic Arc Welding in the Construction of Schlachthof Bridge in Dresden (Automatisches Lichtbogen-Schweissen beim Bau der Schlachthofbrücke in Dresden) K. Siems. *AEG—Mitteilungen,* May 1933, pages 92-96. The electric equipment methods and some details of construction for welding the bridge of 315 m. length are described. 14,000 m. of welding seams were applied; the bridge is entirely welded. Comparisons of manual and automatic welding gave considerably better results for the latter method with regard to length/hr. welded and consumption of electrodes/unit length. Tables for different thicknesses of seam and different diameters of electrodes are given. Ha (7b)

Good Welding vs. Prevailing Trade Practices on Welded Pressure Vessels. F. G. Sherbondy. *Industry & Welding,* Vol. 5, June 1933, pages 2-7. Discusses welding code of the American Society of Mechanical Engineers and some practices in indiscriminately using or prescribing welding against riveted joints. Certain regulations are held burdensome on the users of welded pressure vessels, and a more practical interpretation of some regulations is recommended. Ha (7b)

FINISHING OF METALS & ALLOYS (8)

H. S. RAWDON, SECTION EDITOR

Pickling (8a)

Pickling of Refrigerator Parts Is Made Automatic by Conveyors. *Steel,* Vol. 92, Jan. 16, 1933, pages 17-19. Describes several types of automatic conveyors for cleaning and pickling. MS (8a)

The Effects of Pickling on the Properties of Carbon Steels. IAN G. SLATER. *Iron & Steel Institute,* Advance Copy No. 14, Sept. 1933, 16 pages. Patented and patented-and-cold-drawn steels containing up to 1% C were pickled in different acids and electrolytically. Pickling in H_2SO_4, HCl, or HNO_3, or by electrolytical means decreased ductility as measured by a torsional test. The loss in ductility increased with increasing C content. Inhibitors such as flour, yeast, and $SnCl_2$ in pickling bath retarded the deterioration. The rate of recovery at different temperatures was studied. In a number of C-steels pickling increased the notched-bar impact resistance. Tensile tests indicated that pickling slightly raised tensile strength, slightly reduced elongation, and greatly reduced reduction of area. 7 references. JLG (8a)

Cleaning, including Sand Blasting (8b)

Sandblasting of Boilers (Reinigung von Dampfkesseln durch Sandstrahlgebläse) *Feuerungstechnik,* Vol. 21, July 15, 1933, page 106. Instead of steel brushes, sand-blasting has been successfully employed in Germany for cleaning the outside of boilers in service. Detailed data on expenses are given. In order to decide whether boiler material will be adversely affected, samples were examined after treatment; only a small amount of wear and negligible deformation of the microstructure were noted. On Cu and brass peculiar destructive effects were noticed, which however, could be eliminated by lowering the air pressure and by utilizing a suitable kind of sand. Sea sand is mildest in its action while ground quartz has sharp edges and corners. Sand-blasting for cleaning the inside of boilers is suggested. EF (8b)

The Manifold Uses of the Sand Blast. *Engineering Progress,* Vol. 14, Mar. 1933, pages 59-60. Sand blasting is used for cleaning castings in foundries, for cleaning articles before galvanizing and Ni plating, for removing oxide from sheets and other rolling-mill products in place of pickling, for cleaning files, graining zincograph plates, removing the scale from tools after hardening and for partial or complete matting of high-class Au, Ag, and steel ware. RHP (8b)

Metal Cleaning before Electro-Plating. *Engineer,* Vol. 156, July 14, 1933, pages 45-46. Recommends use of a compound containing aluminate and silicate of K and Na. This chemically attacks animal and vegetable oils and fats and converts them into water-soluble soaps; at the same time the soft colloidal suspended matter scours the surface of the article and mechanically removes all dirt and mineral oils. Illustrations given of properly and improperly cleaned metal. LFM (8b)

Polishing & Grinding (8c)

Finishing of Rolls by Grinding. CARL MOREY. *Iron Age,* Vol. 129, June 30, pages 1388-1389; Vol. 130, July 14, pages 54-55; July 28, 1932, pages 140-141; Aug. 11, 1932, pages 218-219, adv. sec. page 20. First cast Fe roll having a chilled surface was made by Garrison Works, Pittsburgh, in 1806. Following the steel roll, the alloy Fe roll was developed. As to finish of rolls, grinding produced better surface than the lathe. Polishing and buffing of rolls is only a question of time. Crowning and concaving rolls to compensate for deflection and thermal expansion, respectively, and assure straight line bite between rolls, is discussed. Cross and straight-edge methods of roll turning was used until advent of roll grinder when generated curves were introduced. Some builders use the same curve for both crown and concave. Simple harmonic curve is close enough to elastic curve for all practical purposes. Considers briefly the adjustable crank, eccentric sine bar, heart shaped cam and double eccentric. Some of the latest improvements are known as swing rests, motorized spindles and other components. Many machines designed with as many different characteristics will do satisfactory work. VSP (8c)

Grinding of High Carbon-High Chromium Steel. W. L. TODD. *Grits & Grinds,* Jan. 1932, pages 2-7. Recommendations on proper selection of grinding wheels for Cr steels (12.01-17.0% Cr, 1.38-2.38% C, low amounts of Mn, Si, Ni, P, S, Co, V, Mo, W) in annealed, hardened, hardened and drawn state. Suggestions regarding proper machining conditions are given. Factors influencing grinding operation, machinability, tendency to burn, check or crack, wheel selection are taken up. EF (8c)

Automatic Grinding and Polishing Machines for Mass Articles. (Schleif- und Polier-Automaten für Massenteile.) *Oberflächentechnik,* Vol. 9, Dec. 6, 1932, pages 244-246. Several automatic machines for grinding and polishing of reflectors, round, flat and irregular pieces, etc. are described. They save time by clamping and unclamping the pieces to be operated on. Ha (8c)

Artificial Grinding Materials. (Systematik der Schleifmittel aus künstlichen Rohstoffen.) *Technische Blätter der deutschen Bergwerkszeitung,* Vol. 22, Dec. 4, 1932, page 645. Brief discussion of production and application of SiO and Al_2O_3, grading, hardness and methods of binding of such grinding wheels. General rules to be followed in using such grinding wheels. GN (8c)

Grinding Apparatus for Screw Taps. (Hinterschleifapparat für Gewindebohrer.) *Die Werkzeugmaschine,* Vol. 36, Nov. 15, 1932, page 396. Apparatus described marketed by Loewe-Gesfürel Co., Berlin, is to be used either as auxiliary apparatus for tool grinding machines or direct on the lathe. GN (8c)

Developments in High-Speed Snagging Machines. *Foundry Trade Journal,* Vol. 47, Aug. 4, 1932, page 62. A description of improvements in the fettling shop of Leyland Motors, Limited, where 6 double-ended grinders have been replaced by a pair of modern high-speed machines, using Bakelite-bonded wheels. OWE (8c)

Charts for Cylindrical and Surface Grinding Time. *American Machinist,* Vol. 76, Oct. 26, 1932, pages 1101-1102. Proper speeds for feeding and grinding for roughing and finishing work can be taken from the charts. Ha (8c)

Reducing Polishing Costs by Tumbling. GEORGE S. BRADY. *Iron Age,* Vol. 131, Feb. 23, 1933, pages 303-304, adv. sec. page 12. Increased interest in tumbling in past 3 years has risen from the desire to reduce costly hand polishing. Success depends on a number of factors: size and shape of piece, kind of metal, finish desired, type and speed of barrel, abrasive used, quantity of work in barrel and time required in barrel. Dry tumbling or coloring and wet rolling are discussed. VSP (8c)

Polishing (Aus der Praxis des Polierens) F. RIEDEL. *Oberflächentechnik,* Vol. 10, Feb. 21, 1933, pages 39-40. The author gives the following definitions: Grinding consists in equalizing unevenness of a surface, and making it smooth; polishing is a similar process carried out at much higher velocities (2000-3000 r.p.m. of the polishing wheel). The composition of polishing discs or wheels, and the polishing agents, iron oxide, Viennese chalk, chromium oxide, etc., are discussed and different methods and apparatus briefly described. Ha (8c)

Lapping Process Generates Precision Surfaces. FRED B. JACOBS. *Modern Machine Shop,* Vol. 6, Aug. 1933, pages 28-31. Practice and methods and machines for lapping are briefly described. Lapping is said to be a very old metal working method as the natural emery deposits in Asia Minor have been used by ancient peoples. Ha (8c)

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Gear Lapping as a Production Job. SAM TRIMBATH. *American Machinist,* Vol. 77, Sept. 1, 1933, pages 590-593. Lapping is recommended as finishing operation for gears for quiet operation. Lapping methods and materials are discussed. Ha (8c)

Efficient Grinding of Irons (Rationelles Schleifen von Bügeleisen) E. WERNER. *Oberflächentechnik,* Vol. 10, Sept. 26, 1933, pages 209-210. Discussion of proper methods for manual and automatic grinding; in the latter, particular care must be taken that the piece does not get too hot since the binder of grinding wheel and the grinding material deteriorate. Proper grading of grain fineness is also important. Ha (8c)

How to Obtain Best Results in Roll-Grinding. H. J. WILLS. *Machinery,* N. Y., Vol. 39, Jan. 1933, pages 310-312; Feb. 1933, pages 374-376; Mar. 1933, pages 437-440; Apr. 1933, pages 505-507; May 1933, pages 565-567. There are no standards of surface and finish by which results of roll-grinding can be gaged. Al-oxide wheels with a 150 grit will usually give a surface superior to that given by Si-carbide wheels with 500 grit. Characteristics of the material such as hardness, tensile strength, ductility, composition and other factors must be considered in making various rolls. Flats, chatter, grit and traverse marks must be guarded against. A high quality ball or roller bearing, or a properly lapped cap or sleeve bearing of bronze or babbitt metal, with the right oil and heat clearance tend to give a reliable wheel spindle which largely eliminates chatter, work-concentricity, burning and scoring. Neck rests for chilled iron and steel rolls should be redressed frequently. For best results roll supports or rests should be somewhat shorter than the length of the journal bearings, unless the necks are newly ground. The width of the rests may vary. Hold-down clamps to steady the roll are helpful. Neck rests should be lubricated during the grinding. Rolls should be driven by at least two points. Maximum wheel speed obtainable without introducing vibration should be used for all truing passes and the minimum smooth rotation point for finishing passes. Soft water or soda water are suitable for coolants. Filters can often be used to advantage to secure cleanliness. Considers wheel stresses, shapes and sizes. Rigid, non-vibrating machine elements permit the use of soft wheels, with a resultant increase in production and without loss of abrasive efficiency. Wheel balance is essential. For roughing a traverse of from ½ to 2/3 of the wheel width per revolution is best, and for finishing a maximum of ¼ inch per revolution. Coarse wheels often cause scratches or "fish-tails." Hardened steel rolls usually require higher grade grinding than chilled iron rolls. Grit size may range from 50 through 80, 150, 320, to 500. Chilled iron rolls are best ground with Si-carbide wheels. Generally 24-36 grit wheels are used for roughing and 60-70 grit wheels for finishing. Jewelers' rolls constitute a distinct class of grinding. These are comparatively small, require very high surface perfection, dimensional accuracy, and polish. Popular wheel sizes for grinding jewelers' rolls are from 8 to 12 inches in diameter, and from ½ to 1 inch wide. Edges should be well rounded to prevent traverse marks and gouges. Al-oxide wheels are preferable for grinding Cr-plated rolls. Heating must be avoided, this requires light feeds and a soft grade wheel. Paper mill roll grinding involves considerable accuracy, although the requirements for surface and finish are not so exacting as for metal rolling. Roll sag and roll vibrations in the grinder, due largely to the great roll lengths and small diameters present a problem peculiar to the paper industry. Roll sag is decreased by 2 or 3 point neck rests. Specific directions are given for the grinding of rubber rolls, Steckel-mill rolls, foil rolls and copper rolls for intaglio printing as well as for roll scouring and polishing, lapping small rolls, use of split cast iron laps, use of contracting lead laps, and trimming risers from roll necks. Summarizes the common causes of grinding troubles and their remedies. RHPp (8c)

Electroplating (8d)

Influence of Base Metal, in Particular Nickelplating, upon the "Throwing Power" of Chromiumplating Baths (Der Einfluss des Grundmetalles, insbesonders der Vernicklung, auf die Streufähigkeit von Chrombädern) J. Korpiun & Ernst Vogel. *Oberflächentechnik,* Vol. 10, Nov. 7, 1933, pages 243-244. The throwing power of Cr plating baths is inherently low; means for improving it are briefly reviewed. A method for determining throwing power is described and results given to show the improvement which can be obtained by the base metal itself; the following figures are only relative:

Cathode material	Throwing power
Iron, sheet, 0.25 mm., degreased electrolytically	about 1.5
degreased with lime and 25% HCl, 15 sec.	6.0
Copper, sheet, 0.25 mm., degreased electrolytically	4.0
degreased with lime and pickled in ammonium persulphate	7.5
Nickel bath 1, dull white deposit,	9.5
2, dull white deposit,	10.0
3, silky deposit,	12.0
4, weakly bright deposit,	13.0
5, very bright deposit,	14.5

If the Ni deposit is polished before Cr plating the figures for bath 1 and 2 drop to 6.5 and 7.5 resp. In general, the throwing power of Cr plating baths is lower on polished than on dull Ni deposits. Very bright Ni deposits of fine grain improve the throwing power. Ha (8d)

Study on Chromium Plating (Etude sur le Chromage) J. Claymann. *Science et Industrie,* Vol. 17, June 1933, pages 278-280; July 1933, pages 321-324. General but important study on chromium plating processes. Author's conclusions can be summarized as follows: the hardness of a Cr coating is dependent upon H content, this hydrogen being occluded, dissolved or even in the combined state in the deposited Cr. Since the H content of coating is a function of the cathodic H evolved, it is concluded that Cr behaves like Fe or Pt with H. A Cr hydride would be formed which would impart hardness, brightness and inoxidability to the coating. Tests have shown that Cr coatings deposited by the hot process are superior to those obtained by cold process. It seems difficult to obtain with Cr an efficient protection of the underlying or coated metals since Cr is less electro-negative than those metals. Compound or multiple coatings ordinarily use Ni + Cu + (Ni) + Cr for Fe or Ni + Cr for brass, are quite effective because Ni is deposited in the passive state. Passivity of Ni plate is reduced by polishing. This operation is necessary because it is very difficult to deposit a metal on another in the passive state. It is useless, therefore, to obtain a bright Ni coating when this is to be Cr plated. On the contrary a Cr coating requiring no polishing must be obtained in order to preserve its brightness and inoxidability. FRp (8d)

Cold Chromium Plating (La Cromatura a freddo) O. Macchia & D. Raffaelli. *L'Industria Meccanica,* Vol. 15, Oct. 1933, pages 793-795. Results of Cr plating with cold baths (up to 45° C.) are compared with those of heated baths. Data show that cold-plating is more economical as it eliminates the necessity of arrangement for heating the bath, requires lower current density and therefore smaller generators with lower initial cost and maintenance and less space; the equipment for removal of noxious fumes can be much smaller as these are reduced to a minimum by low current density. Best plating conditions are discussed. 24 references. Ha (8d)

Tungsten Plating (La Tungstenatura) O. Macchia. *L'Industria Meccanica,* Vol. 15, June 1933, pages 475-477. Electrolytic W deposits have a brightness similar to Ag but inferior to Cr, and are very resistant to chemical and atmospheric influences. Methods for W plating are reviewed; the sodium carbonate bath of Fink and Jones and the phosphate bath of Holt and Kahlenberg give, at present, the most satisfactory results, though not yet commercially feasible. 17 references. Ha (8d)

Electroplating Copper on Manganin. C. R. Coseus. *Journal of Scientific Instruments,* Vol. 10, Aug. 1933, pages 256-258. Describes a successful method for copper plating manganin (Cu 84, Mn 12, Ni 4) resistance coils. They are copper plated to facilitate subsequent soldering. Coils had been damaged by older methods of soldering. RAW (8d)

Difficulties of Electrolytic Chromium Plating (Le Difficolta della Cromatura elettrolitica) O. Macchia. *L'Industria Meccanica,* Vol. 15, Apr. 1933, pages 319-323. Literature review discussing difficulties in Cr plating due to unsuitable composition or bath temperature, and the advantage of previous Ni deposit. Use of some of the special steels instead of Cr plated steels is sometimes advisable. 23 references. Ha (8d)

Rhodium Plating (La Rodiatura) O. Macchia. *L'Industria Meccanica,* Vol. 15, Aug. 1933, pages 621-622. Electro deposited Rh has lately been successfully employed for reflectors. Its high reflecting power, resistance against concentrated H_2SO_4, HNO_3 and HCl, its great hardness, brilliant white color which it loses only at 300° C. are important for this use. It can be deposited directly on Pb, Sn, Sb, Cd, Cr, Fe, brass, Ag, Ni, Pt, stainless steels and white metals. A table of comparative physical properties of Rh and other metals for the same purpose is given. 16 references. Ha (8d)

Electrolytic Tinplating (La Stagnatura Elettrolitica) O. Macchia. *L'Industria Meccanica,* Vol. 15, July 1933, pages 534-536. Methods for electrolytic deposition of Sn are reviewed and their merits compared. The principal baths used today are those of Proctor (4 l. H_2O, 350 g. sodium stannate, 60 g. sodium acetate, 30 g. NaOH, 2-4 g. sodium perborate), of Oplinger (4 l. H_2O, 350 g. sodium stannate, 30 g. NaOH, 60 g. sodium acetate, 8.5 g. H_2O_2, 3.5 g. sodium perborate) and of E. Maeder (4 l. H_2O, 930 g. sodium stannate, 0.8 g. stannous chloride). Pure Sn anodes are used, with 2-6 amp./dm.^{2} current density at 4-6 volts; temperatures of the baths are 71°-80° and 60°-70° and 43°-50° C. respectively. 19 references. Ha (8d)

The Significance of Cold Chromium Plating (Die Bedeutung der Kaltverchromung) E. Werner. *Die Metallbörse,* Vol. 23, Sept. 9, 1933, pages 1150-1151. Advantages of the new "cold Cr-plating process" are (1) elimination of heating equipment, (2) non-dulling of objects taken out of the bath and returned for further plating, (3) bright deposits at only 3 volts at arbitrarily low temperature, (4) greater throwing power, (5) higher current efficiency. Two tables are presented comparing data on Cr plating experiments of Haring and of Pfannhauser at 35° C. These tests indicate higher current efficiency the lower the chromic acid content. The author's tests at 26° C. yielded a deposit of 0.04-0.05 mm. in 2 hrs. Microscopic examination showed finely crystalline deposits free from cracks. The author questions American tests yielding an optimum working temperature of 55° C. EF (8d)

The Problem of Electrolytic Deposition of Alloys (Zur Frage der elektrolytischen Abscheidung von Legierungen) S. A. Pletenew & W. W. Kusnezowa. *Zeitschrift für Elektrochemie,* Vol. 39, Apr. 1933, pages 201-204. Influence of current density, pH value of the solution, temperature and stirring velocity on the deposition of Co-Ni alloys from sulphate solutions were investigated. Results do not confirm those of Fink and Lah (Deposition of Nickel-Cobalt Alloys, *Metals & Alloys,* Vol. 1, Dec. 1930, page 910) that the Co-content increases with pH. The contrary was found. The reason is attributed to polarization by the presence of complex ions $[Co(SO_4)_2]''$. It was also found that the percentage of Co in the deposited alloy decreased with increasing current density. An increase of temperature of the solution lowered the Co-content of the deposit due to reduction of polarization which favors deposition of Ni. Vigorous stirring usually reduced the Co-content of the deposit but these conditions have not been clarified yet. Ha (8d)

A New Form of Electrolytically Deposited Chromium (Ueber eine neue Form von elektrolytisch abgeschiedenem Chrom) B. Rassow & L. Wolf. *Angewandte Chemie,* Vol. 46, Mar. 4, 1933, pages 141-142. While deposits from sulphuric-chromic acid solutions alloy with the base metal with great readiness, even in thicknesses of 4-7 μ, in 2-4 hrs. deposits from solutions containing complex fluoric acids show great resistance to diffusion into the base metal. The reason is seen in the different cathodic depositing conditions created by the foreign acids. This is evidenced particularly by Cr deposited on brass, where a great proportion of Zn of the surface layer diffuses through the Cr layer. The possibility of a change of crystal lattice of Cr being the reason for this is discussed. Ha (8d)

Technique of Cadmium Plating (Sulla tecnica della cadmiatura elettrolitica) F. Pietrafesa & E. Lotti. *La Metallurgia Italiana,* Vol. 25, Mar. 1933, pages 167-173. The concentration of the bath giving the optimum results with respect to the different constituents is Cd, 0.75 N [as $Na_2Cd(CN)_4$]; free NaCN 1 *N*; NaCl 0.75 *N*; with various added organic substances to improve the quality of the plating. (These are not named so as not to divulge important trade secrets). The influence of current density from 0.5 to 5 amps./dm.^{2} at temperatures of 10, 20, 30, 40, 50° on the quality and quantity of the deposits is noted. Very inferior results are obtained at the high current density and low temperature, and vice versa. Optimum results are obtained at 2 amps./dm.^{2}, and at 20° C.; the anode and cathode yields, under these conditions are almost identical, $R\ (\text{anode})/R\ (\text{cathode}) = 1.01$. The organic additions produce lustrous deposits and eliminate the polishing operation. AWC (8d)

Zinc-and Copper-Coated Steel. *Machinery,* New York, Vol. 39, Feb. 1933, page 392. Brief note on the advantages of electroplated coatings over "hot dip" coatings. RHP (8d)

Nickel Plated Aluminum Knitting Needles (Vernickelte Aluminiumstricknadeln) *Oberflächentechnik,* Vol. 10, Nov. 21, 1933, page 258. Manufacturing process is described. Needles 29 and 39 cm. long and 3-4 mm. diam. are pickled in 20% NaOH and rinsed in 1:1 HNO_3 containing a few drops of HF; they are then bright silvery. They are then Zn-plated; Ni is then deposited in a bath of 10 kg. nickel sulphate (20 g. Ni per l.), 1.5 kg. sodium citrate, 1.5 kg. sodium sulphate, 1 kg. boric acid, 200 g. NaCl; 50 g. citric acid is used for acidifying. Water is added to bring concentration to 12° Be (sp. gr. = 1.090), pH = 5.7-6.0. The plated needle must stand bending without cracking of the coating. Ha (8d)

Progress in Chromium Plating (Fortschritte in der Verchromung) *Oberflächentechnik,* Vol. 10, Oct. 10, 1933, pages 219-221. A review of present-day Cr plating methods. The properties of electrolytic deposits are discussed, the best methods for Cr plating of Fe, brass, red brass, Al castings and Zn die-castings and suitable intermediary layers described. Cr plating is used in nearly all industries, except for moving parts of machines as the brittleness of Cr prevents its use here. Ha (8d)

New pH Test Set for Nickel Plating Solutions. *Platers' Guide,* Vol. 29, Nov. 1933, page 20. The Kocour Co., Chicago, Ill., has a new portable pH test set that can be used at the tank. It is simple to operate and consists of eight color standards, sealed tube of water, three graduated test tubes, graduated dropping pipette, bottle of indicator solution, brush and direction card in a hardwood, brass-mounted box. WHB (8d)

The Production of Sherrite Steel Sheets. *Engineering,* Vol. 135, May 26, 1933, page 584. Short note on process developed by Sherard Cowper-Coles for electro-plating steel plates with Zn. An automatic machine is used which can coat standard-size sheets at the rate of several a minute. By changing the anodes and electrolytes steel sheets can be coated with brass or Cu. LFM (8d)

New Continuous, High-Speed Zinc Plating Process. *Automotive Industries,* Vol. 69, Aug. 12, 1933, page 182. A new process has been developed for electro-depositing zinc on steel sheet. Sherard Cowper-Coles, inventor of the sherardizing process, much used for rust-proofing electrical fittings, is responsible for this new work. By a continuous and automatic process, standard size sheets are Zn-plated at the rate of several a minute. The product, called Sherrite steel sheet, does not rust even at a cut edge. Brass and copper may also be plated on steel in the same way. DTR (8d)

Preparation Method for Processing Corrosion Resistant Platings on Materials Hard to Work (Vorbereitungsmethode zur Herstellung korrosionsbeständiger Überzüge bei schwer zu verarbeitenden Materialien) *Deutsche Goldschmiedezeitung,* Vol. 36, Aug. 26, 1933, pages 364-365. Difficulties encountered in electroplating W steel sheets were attributed to non-uniform structure and non-metallic inclusions. By pickling such sheets before Ni plating in acid solution of $FeCl_3$ and $Fe(NO_3)_3$ impurities were removed and corrosion resistant plating obtained. GN (8d)

Electroplating of Aluminum (Elektroplattierung von Aluminium) H. K. Werk. *Aluminium,* Vol. 15, Oct. 31, 1933, pages 4-6. Before plating, degreasing is carried out preferably in a solution of 7.5-22.5 g. each of triphosphate of sodium and soda at 80-95° C.; after rinsing, the article is dipped in 5% HF 10-15 sec. for Ni plating and 60 sec. for Zn plating. For better adherence of the plating the surface is then roughened by a pickling bath; pure Al in 270 g. Ni chloride, 0.2 l. HCl, 1 l. H_2O, at 30° C. for 15-30 sec.; rolled Al alloys in 1/3 l. HCl of 1.18 sp. gr., 2/3 l. H_2O, 15 g. Mn sulphate, temperature and time as before; cast alloys in 3 parts (volume) HNO_3, 1.42 sp. gr., 1 part 48-52% HF, 25° C., 15-30 sec. for die-castings, 30-90 sec. for chill-mold castings, 60-120 sec. for sand castings. A good Ni plating bath is composed of 150 g. Ni sulphate, 75 g. Mn sulphate, 15 g. ammonium chloride, 15 g. boric acid, 1 l. H_2O, 35° C., 1.5 amp./dm.^{2} current density, pH (colorimetrically) 5.8-6. Other metals can be deposited on the Ni. Zn and Cr can be deposited directly on Al without roughening it. Procedure and precautions to be observed are discussed. Ha (8d)

Bearings Are Reclaimed by Copper Plating. *Transit Journal,* Vol. 77, Dec. 1933, page 444. Bronze armature bearings and similar badly worn bronze bearings are reclaimed at the International Railway, Buffalo, N. Y., by Cu-plating before rebabbitting. A Cu layer of .002-.007″ is deposited on the outside of the bearings to insure a tight, permanent press fit in the housing. Equipment consists of a standard acid Cu plating bath and tank with bars for suspension of the bearings, a motor generator set for obtaining low-voltage d.c., an instrument panel with ammeter, voltmeter, field rheostat for regulating the voltage, etc.; 1200 amps. at 12 volts are required. WHB (8d)

Test of Thickness of Protective Cadmium Coatings on Steel. S. G. Clarke. *Metal Industry,* London, Vol. 43, Aug. 11, 1933, pages 153-157. Methods for rapid determination of thickness were compared. By the iodine dropping method, the thickness is obtained from the number of drops of a specified iodine solution required to perforate the coating. This method was found accurate to ± 1.5% and is applicable to most Cd plated surfaces except of very small dimensions. By the HCl-$SbCl_3$ stripping method the coating is dissolved in a specified solution and the thickness determined by loss in weight, reduction in dimensions or time required for stripping; it is well adapted for small parts as long as dimensions can be measured accurately. Ammoniacal ammonium persulphate stripping method is in the same class. Ha (8d)

Silver Plating of a Phosphor-Containing Base Metal; a Contribution to Electrolytic Degreasing (Die galvanische Versilberung von phosphorhaltigem Grundmetall; ein Beitrag zur Frage der elektrolytischen Entfettung) M. Moser, K. W. Froehlich & E. Raub. *Angewandte Chemie,* Vol. 46, Sept. 2, 1933, pages 562-565. The reason for frequent occurrence of inferior silver deposits on Ag-Cu alloys was found in the presence of P in the base metal, resulting from excess P in deoxidation, or the presence of cuprous oxide. Electrolytic degreasing of such materials is usually not complete, but if the articles are immersed for a few minutes in a boiling 10% solution of KCN, cuprous oxide and copper phosphide are dissolved and the subsequent plating is of good quality. Ha (8d)

Use of Bimetallic Anodes in the Electrolytic Synthesis of Alloys (Emploi d' anodes bimétalliques dans la synthèse électrolytique des alliages) C. Bechard. *Comptes Rendus,* Vol. 196, May 15, 1933, pages 1480-1482. I. When an alloy of 2 or more metals is deposited electrolytically, there is generally used as anode a substance resistant to attack of electrolyte, or alloy to be deposited. Experiments have been made on deposits of Cu-Zn alloys, by using bi-metallic anodes formed of a strip of Cu and a strip of Zn. ratio of surfaces of which could be varied at will. The electrolyses were carried out in series in cyanide baths rapidly agitated. Each series comprised 5 vats which differed from each other only in the relative areas of Zn and Cu—and a control vat in which anode consisted of brass (66% Cu—34% Zn). The relative areas Zn/Cu of anodes in 5 vats corresponded with following ratios: 5/1, 4/2, 3/3, 2/4, 1/5. A series of experiments was made, each of 96 hours' duration. The tests were interrupted every 24 hours and deposits analyzed. Finally, the Cu and Zn in bath were determined. It was thus possible to follow evolution of deposits and initial composition of bath being known, to establish complete balance sheet for each test and to make clear changes which took place in electrolyte. The results support following conclusions:

1. By using an anode of brass and conditions which result in formation of a deposit rich in Cu (80%, for example), it has been proved that anodic dissolution of Cu does not keep pace with its deposition on cathode: hence, Cu content of bath is reduced and surface of anode assumes appearance of Zn. This becomes apparent only at the end of a certain time, but at this moment anodic solution of Zn becomes preponderant: concentration of Zn increases in bath. As a result, Zn content of deposit increases until, excess Zn on anode having been dissolved, it resumes its brassy appearance. There is evidently a lag between modifications of course of anodic solution and corresponding variations in composition of deposited alloy. This lag is clearly due to an inertia effect of the bath. Variations in composition of deposited alloys continue throughout entire duration of experiment. They correspond to a periodical phenomena, to a veritable auto-regulation by the anode of composition of bath and of composition of deposit. Following values justify this conclusion with respect to the composition of the cathodic alloy.

Brass Anode

Density of Current: 300 Milliamps./dm.^{2} of Cathode.

Copper Content of Deposit at End of:

24 hr.	48 hr.	72 hr.	96 hr.
57.5%	64.2%	62.8%	66.6%

2. Same phenomena of auto-regulation is observed with anodes composed of pure metals; but, though frequency of variation in composition of deposited alloy is practically same, amplitude is much greater, as following example shows:

Anode No. 2

Ratio of Surfaces Zn:Cu = 5

Density of Current: 300 Milliamps./dm.^{2} of Cathode.

Copper Content of Deposit at End of:

24 hr.	48 hr.	72 hr.	96 hr.
36.6%	22.5%	53.6%	50.6%

3. Generally speaking, experiments show that amplitude of variations in composition of deposited alloy becomes greater as composition of bimetallic anode deviates from alloy most susceptible of being deposited under given experimental conditions (composition of bath, current density, temperature, etc.).

4. In case of a brass anode, predominance of anodic solution of Cu has effect of enriching surface of the anode in Zn, which ultimately prohibits Cu from being taken up by the electrolyte. This simple mechanism cannot occur in case of bimetallic anodes. Here the arrest of the excess solution of one of the 2 metals of the anode is effected by formation of local couples established between 2 metals and causing, as a result, deposition of one metal on other. It has, in fact, been observed that, when demand for Cu has been excessive, an electrolytic deposit of Zn is formed upon Cu of anode. Converse has been as frequently observed.

II. It was thought advisable to avoid effect of imposing in advance a definite composition for cathodic deposit, and to start with a solution of KCN free from metals to be deposited. Under these conditions anodic attack by the cyanide anion causes solution of Cu and Zn in proportions which depend primarily on ratio of surfaces of 2 metals exposed at anode. Cu and Zn content of bath determines in its turn composition of alloy which is deposited on cathode. Once a deposit of alloy forms, phenomena described above, of periodic variations of 3 interdependent magnitudes, are noted: ratio of rates of anodic solution of 2 metals, composition of solution, composition of deposited alloy. OWEp (8d)

Passivity Properties of Metals (Passivitätserscheinungen an Metallen) Max Schlötter. *Chemiker-Zeitung,* Vol. 57, July 8, 1933, page 533. From Ag solutions containing about 1% I, Ag can be electro-deposited which has the color of Au and does not darken when it comes in contact with K_2S although it becomes blue when exposed to light. Cu and Ni act similarly. The color of Ni deposits varies from dull to lustrous black and gray according to the amount of oxide in the Ni deposit. Likewise, the bluish, black and white colors obtained in Cr plating are due to oxides in the deposit. It is believed that such deposits are passivated as they are not attacked by reagents in the usual way. CEM (8d)

Udylite Develops New Test Method for Cadmium. *Platers' Guide,* Vol. 29, Oct. 1933, pages 11-12. A stripping test for determining thickness of plated Cd coatings developed by the Udylite Process Co. consists of 2 solutions (composition not stated), one of which (5A) dissolves Cd plate at rate of 0.00005" in about 30 sec. and produces a brown surface film; the other (5B) dissolves this film. The test specimen is immersed in one (5A) for 15 sec., rinsed with water and inspected. If the whole surface is covered with a brown film the minimum thickness of the plate exceeds .00005". The film is removed by immersion in the solution, rinsing in water and then immersing for another 15 sec. in the first solution. The inspection now shows whether the minimum thickness exceeds .00010". This procedure is repeated until the base metal stands out against the brown film on the plate which is the end point. If n = number of immersions required to expose the base metal, then (n-1)0.00005" is a numerical indication of the minimum thickness. WHB (8d)

Practical Plating. E. A. Ollard. *Metal Industry,* London, Vol. 42, Apr. 14, 1933, pages 403-405; Apr. 28, 1933, pages 451-454; May 26, 1933, pages 549-550; June 23, 1933, pages 643-645; Vol. 43, July 21, 1933, pages 59-60; Aug. 4, 1933, pages 107-109. Preparation and cleaning of work for plating are discussed exhaustively, equipment and agents for degreasing, boiling in caustic or other alkali solutions, current adjustment, etc., described. A schedule for new and old work for going through the plater's shop is worked out; the importance of proper cleaning processes for the quality of product and plant economy pointed out. Treatment of polished articles, anode picklers, use of restrainers, pickling of dissimilar metals, solutions for Ni plating and the value of additions of chloride, fluoride and boric acid, magnesium and sodium sulphate, citrates, acetates and others for obtaining bright deposits are discussed. Cu or Zn in Ni-plating solutions is detrimental. Formulas for warm rapid plating solutions, for ordinary jobbing plating, for plating Zn-base metals and for hard, heavy deposits are given and current densities specified. Ha (8d)

The Standpoint of the Practical Man towards Cold-Chromium Plating (Die Stellung des Praktikers zur Kaltverchromung) Eugen Werner. *Oberflächentechnik,* Vol. 10, Aug. 1, 1933, pages 179-180. Against many objections the author maintains and proves from practical experiences that cold Cr plating, i.e. about 20° C., gives entirely satisfactory results and that with the proper electrolyte bright and dense deposits can be obtained. In particular it is pointed out that the presence of other acids in the Cr electrolyte does not have as important influence at low temperatures as at high temperature. Ha (8d)

Electrolytic Deposits on Aluminum (Galvanische Niederschläge auf Aluminium) H. Krause. *Mitteilungen des Forschungsinstituts und Probieramts für Edelmetalle,* Vol. 7, Oct. 1933, pages 87-89. Ni-plating of Al and Al-alloys is discussed. The metal must be degreased in a hot (90° C.) solution of 7.5-22.5 g. each of trisodium-phosphate and soda/l., rinsed in cold water and immersed in a 5% HF bath; the surface is then roughened in a sandblast, or better in a pickling bath, to make the deposit adhere well. The Ni solution consists of 150 g. $NiSO_4$, 75 g. $MgSO_4$, 15 g. NH_4Cl, and 15 g. boric acid/l. It is used at 35° C., with 1.5 amps./dm^2. current density and a pH of 5.8-6. A minimum thickness of 0.0125 mm. is recommended. Any other metal may be deposited on the Ni; Zn and Cr can be applied directly on Al. Ni-plated Al is not suitable for further working; heat-treatment improves its behavior especially for articles for high temperature use. Recommended treatment: heat for 1 or 2 hrs. to about 120° C., gradually increase to 315° and hold for several hrs. Hap (8d)

Detection and Significance of Porosity in Electrodeposited Cadmium Coatings on Steel. S. G. Clarke. *Metal Industry,* London, Vol. 43, July 7, 1933, pages 15-16; July 21, 1933, pages 61-62; Aug. 1933, pages 109-110. A porosity test for Cd coatings on steel was developed which consists in immersing the absolutely clean specimen for a few minutes in dilute HCl (1%) and noting the formation of H bubbles occurring at discontinuities of the deposit; the test is claimed to be non-destructive for the coating. Cd coatings even as thin as 0.00005 inch, from cyanide solutions on rolled steel were found substantially non-porous. Porous and discontinuous coatings are attacked more rapidly than continuous coatings. The deciding factors seem to be the total area of steel exposed at the discontinuities and the severity of the corrosive conditions. With highly-porous coatings and those less than 0.0001" in thickness the effect of pores in accelerating the attack of the coating was considerable, but slight with coatings of 0.0003" and more. In general, slight porosity in a Cd deposit appears not likely to affect its protective properties under ordinary conditions. Hap (8d)

Modern Chromium Plating (Neuzeitliche Verchromung) W. Birett. *Metallwaren Industrie und Galvano Technik,* Vol. 30, Aug. 15, 1932, pages 358-360. See *Metals & Alloys,* Vol. 4, Dec. 1933, page MA 386. EF (8d)

Electrolytic Manufacture of Copper Sheets (La Fabrication des Planches de Cuivre par Voie Electrolytique) R. Baridon. *L'Usine,* Vol. 42, May 12, 1933, page 17. Production of Cu sheet directly in the electrolytic bath from Cu scrap or even Cu-containing scrap is discussed with a brief description of the process of a Swiss company making large Cu sheets in this manner. The sheets have a laminated appearance and are particularly suitable for deep-drawing, roofing, gutters and spouting. Ha (8d)

Methods for Controlling Deposits of Zinc and Cadmium (Methodes de Controle des Depots de Zinc et de Cadmium) J. Bary & P. Orlowski. *L'Usine,* Vol. 42, Oct. 5, 1933, pages 21-23. Methods for comparing Zn and Cd electroplating with respect to resistance against corrosion and industrial methods for checking thickness of deposit are discussed. The "Preece" test for Zn (immersion in 20% $CuSO_4$ solution at 18° C.) is said to give proper indication of thickness for corrosion resistance. For testing Cd deposits immersion of the sample in a solution of HCl of 22° Be, 120 cc. H_2O, 88 cc. $SbCl_3$, 40° Be is recommended; 8 sec. immersion is assumed to dissolve 0.001 mm. Cd. A thickness of 0.004-0.0005 mm. is considered sufficient for effective protection against corrosion. Ha (8d)

Electrochemical Behavior of Platinum. III. (Ueber das elektrochemische Verhalten des Platins. III.) G. Grube & D. Beischer. *Zeitschrift für Elektrochemie,* Vol. 39, Jan. 1933, pages 38-45. The practical possibilities of deposition of Pt from hot electrolytes was further investigated; best deposits were obtained from sodium-ammonium-phosphate solutions and from an ammonical solution of di-nitro-diamine Pt. As the deposition proceeds under very high polarization, H is developed even at low current density. Pt can not be deposited from potassium platinocyanide; only H is deposited, except on Hg cathode in which case a Pt salt forms. Ha (8d)

The Effect of Mercury in Zinc Cyanide Plating Solutions. E. E. Halls. *Metal Industry,* London, Vol. 42, Mar. 3, 1933, page 261. Tests were made to determine the practicability of using Zn anodes amalgamated with Hg for zincplating and to study the relative merits of the resulting Zn deposit on Fe and steel articles as compared with other methods. In certain respects, corrosion-resistance, durability, thickness, etc., the deposits showed some superiority; the only objection, in some cases, may be the darker color. The higher current density which can be applied offers some economic advantages. Ha (8d)

Testing of Metallic Deposits. *Metal Industry,* London, 42, Mar. 17, 1933, pages 307-309; Mar. 1933, page 358. Discussion of paper by C. W. Borgmann, *Metal Industry,* Jan. 20, 1933 (See *Metals & Alloys,* Vol. 4, Oct. 1933, page 317). Tests for quality of metallic deposits must be made with great discretion with due regard for conditions of deposit, base metal, and purpose of deposit. Rapid tests to determine suitability of a coat are sometimes absolutely inadequate and harmful. Ha (8d)

Galvanic Improvement of Zinc Sheet (Die galvanische Veredelung von Zinkblech) J. Hausen. *Oberflächentechnik,* Vol. 10, Mar. 7, 1933, pages 55-57. Improvement of rolled and cast Zn by electroplating finds ever increasing application for industrial purposes, Ni-plating being most common. Preparation of the surface is of special importance. The article is cleaned electrolytically as anode for ½ to 3 min. in a hot solution of trisodium phosphate containing 45 g./l. with current density high enough to produce strong gassing. The surface is then roughened by pickling in 1% HF or 5-10% HCl for about 1 min. The plating bath should preferably have a high sulphate content and an addition of citrate; several recipes are given for use at room temperature with current densities of 1.2-1.8 amps./dm.^{2}. A coating of 0.0075 mm. is sufficient if another metal is to be deposited on the Ni. For thicker deposits the rapid plating process is recommended; the bath having a composition in g./l. of 112-135 g. $NiSO_4$, 22 g. NH_4Cl, 15 g. boric acid and 112 g. anhydrous Na_2SO_4; pH 5.5-5.9 at 24-30° C. and current density 2.4-4.0 amps./dm.^{2}. The minimum thickness of 0.0075 mm. is obtained in 10 min. The throwing power of the bath is good. Subsequent treatments are briefly described. 7 references. Ha (8d)

Size of Electrolytically Developed Gas Bubbles (Über die Grösse elektrolytisch entwickelter Gasblasen) B. Kabanow & A. Frumkin. *Zeitschrift für physikalische Chemie,* Abt. A, Vol. 165, Aug. 1933, pages 433-452. Criticism on the theory of Coehn & Neumann who assume electro-phoretic forces during electrolysis (*Zeitschrift für Physik,* Vol. 20, 1922, page 54). New interrelation between size of electrolytically evolved gas bubbles and contact angle is stated and corroborated by experimental results on Hg, Ag and Pt in solutions of different compositions and concentrations. The forces underlying the equilibrium of a gas bubble sticking to an electrode are calculated. Bubble size depends on the potential difference between solution and metal. Capillary-electrical theory of the bubble size is discussed and confirmed by experiments on Hg; its practical significance is demonstrated in Zn electrolysis. Microscopic examination of surface of Zn deposits shows sometimes small round cavities which have resulted from the adherence of hydrogen bubbles at these spots during electrolysis. The number and size of these cavities give some idea of the adhesive force of the bubble. The study of Zn deposited under different conditions, revealed that the number and size of these cavities decreased with increasing current density, if the acid content of the solutions was raised at the same time. This phenomenon is interpreted on the basis of the theory set forth, i.e. that the cathode potential is shifted to a more negative value and that the contact angle of the bubbles diminishes with increasing current density. Both effects result in lowering the adhesion of the bubbles. EF (8d)

The Control of Electrodepositing Solutions. XIV. The Cadmium Solution. XV. The Chromium Solution. Sam Field. *Metal Industry,* London, Vol. 42, Mar. 17, 1933, pages 309-310; Vol. 43, July 7, 1933, pages 13-14. Difficulties in analysis of Cd solutions are pointed out; 4 determinations are required, free cyanide, Cd content, total alkali and carbonate content. The first 2 are most important; methods for their determination are described. Part XV. The manner of calculating and analyzing the electrolyte in Cr plating solutions is explained and illustrated in detail. Ha (8d)

Spontaneous Deposition of Polonium on Silver in Various Acids (Über die Natur der spontanen Abscheidung von Polonium auf Silber in verschiedenen Säuren) O. Erbacher. *Zeitschrift für physikalische Chemie,* Abt. A, Vol. 165, Aug. 1933, pages 421-426. The phenomena encountered during the spontaneous deposition of Po on Ag in different acids can be interpreted under assumptions based on 2 different occurrences: one phenomenon is based on the electro-chemical exchange of Ag atoms with the nobler Po ions, while the second consists in an incorporation of Po into the lattice of the forming Ag pentoxide. The latter shows the character of a solid solution formation. EF (8d)

The Influence of the Anion on the Electrolytic Deposition and Solution of Cadmium and Zinc (Ueber den Einfluss des Anions auf die elektrolytische Abscheidung und Lösung des Cadmiums und des Zinks) Erich Mueller & H. Barchmann. *Zeitschrift für Elektrochemie,* Vol. 39, June 1933, pages 341-352. Electro deposition of metals from aqueous solutions depends on current density, metal ion concentration, temperature of electrolyte, acidity, additions to the electrolyte, and nature of the dissolved metal salt. The first 5 factors have been fairly well investigated, the present paper deals with an investigation of the influence of the anion of the dissolved salt. Overvoltages accompanying cathodic deposition and anodic dissolving of Cd and Zn are influenced by the electrolyte anion; the current density-polarization curves become less steep in the order chloride, bromide, sulphate, perchlorate. Current efficiency of Cd deposition was found to average 94-99% and to increase with rising temperature. Increased concentration of the anion has a depolarizing effect. Cd can be deposited in thick layers from perchlorate solutions, especially in presence of sodium perchlorate. Addition of gelatine increases overvoltage and gives a finer grained deposit. Ha (8d)

Electrolysis of $ZnSO_4$ solutions. (I) The action of various organic compounds on the electrolysis of solutions of Zinc, in the presence of impurities such as Fe, Co, Ni, As, Sb (Influenza di alcuni composti organische sulla elletrolise di soluzione di zinco, nella presenza di impurita come Fe, Co, Ni, As, Sb) P. Guareschi. *Industria chimica,* Vol. 8, June 1933, pages 704-708; July 1933, pages 822-826. Presence of metals, especially Fe, As, Sb, Co, Ni reduces the quality and yield in electrolysis of $ZnSO_4$. Numerous organic compounds improve the quality of the deposit. Seignette salts, succrose, levulose, gum arabic, tannic acid, were found to help. Strong oxidizing agents, such as $KMnO_4$, and Na_2O_2 also improve the deposit. The presence of Mn is very injurious; it is best to remove this element before attempting the electrolysis. (II) Organic compounds containing one N atom such as cyanamide, also improve the quality of a Zn deposit. Thus, in addition to colloids, many non-colloidal organic compounds capable of forming complexes with Co, Ni, Fe, As, Sb, i.e. oxides of the types M_2O_3, M_2O_4, M_2O_5, or complexes with organic N compounds whic hmigrate to the anode, improve the Zn deposit. For good electrolysis, the drop in current efficiency due to these impurities should not exceed 5%. AWC (8d)

Cold Chromium Plating (Zur Beleuchtung der Kaltverchromung) W. Kampschulte. *Oberflächentechnik,* Vol. 10, Apr. 4, 1933, pages 86-87. Tests have shown that the claims made for equally good quality of Cr deposits at ordinary temperature cannot be maintained as deposits made at 38° C. had throughout about 4 times greater thickness, were also much more resistant and adhered more closely. Ha (8d)

Theory of Chromium Plating (Theorie der Verchromung) E. Liebreich. *Zeitschrift für Elektrochemie,* Vol. 39, July 1933, pages 628-629. The reduction of chromic acid in the chromium plating process was studied. The possibility of a useful deposition of Cr does not depend entirely on a reduction, it is rather a question of the solubility of the oxide and the Cr metal contained in the latter, and of the character of the salt formed. If foreign acids are added the curve representing voltage-current shows branches which are independent of the type of acid added. Ha (8d)

New Electrolytic Deposits (Neuere galvanische Niederschläge) H. Krause. *Feinmechanik und Präzision,* Vol. 41, July 1933, pages 106-108. Plating with Pt and Pd is now used to prevent tarnishing of Ag or white Au, a much thinner layer accomplishing the same protection as silver. Rh deposits are recommended where hardness is of importance; it is best deposited from a sulphate bath containing 1 g. Rh/l. and requiring 4-6 v.; it develops noxious fumes. Several other recipes for Pt, Pd and Rh baths are given. It has been used on Ag but is still too expensive. Mo is deposited from a solution of 10 g. ammonium molybdate and 10-20 g. ammonium nitrate in 1 l. water, with 0.2-0.3 amp./dm.^{2} at about 2 v.; a fine black deposit is obtained. W can be deposited from a bath of 175-180 g. sodium tungstate in 1 l. water at 80°-95° C. and 8-10, and up to 40 amp./dm.^{2} and with a pH value of 13; it is best deposited like Cr on an intermediary layer of Ni. Ha (8d)

Electrochemical Behavior of Palladium I. Electrolytic Deposition of Palladium and Palladium-Silver Alloys from Complex Salt Solutions (Ueber das elektrochemische Verhalten des Palladiums I. Die elektrolytische Abscheidung von Palladium und Palladium-Silber Legierungen aus Komplexsalzlösungen) G. Grube & D. Beischer. *Zeitschrift für Elektrochemie,* Vol. 39, Mar. 1933, pages 131-139. The failure so far of being able to deposit Ag with some other metals to make the deposits mechanically more resistant and non-tarnishing led to experiments with Pd. Simultaneous electrolytic deposition of Pd and Ag is possible from solutions of cyanide of potassium and potassium thiocyanate. Several methods were tried but none gave a satisfactory result with regard to practical applications. 19 references. Ha (8d)

P_3 in the Electroplating Technique (P_3 in der Galvanotechnik) R. Justh. *Oberflächentechnik,* Vol. 10, Mar. 7, 1933, page 57. Triphosphates (P_3) are degreasing agents depending on trisodium phosphate and caustic soda; the latter dissolves very actively in *statu nascendi* greases, fats, oils, etc. The mechanism of degreasing as a chemical, colloid-chemical and a mechanical process is explained. Ha (8d)

The Electrodeposition of Iron-Cobalt Alloys. I. S. Glasstone & J. C. Speakman. *Metal Industry,* London, Vol. 42, Feb. 17, 1933, pages 203-206. See *Metals & Alloys,* Vol. 4, Oct. 1933, page MA 316. Ha (8d)

Electrolytic Deposition of Rhodium (Ueber die elektrolytische Abscheidung des Rhodiums) G. Grube & E. Kesting. *Zeitschrift für Elektrochemie,* Vol. 39, Dec. 1933, pages 948-958. Rh is coming to be used more extensively in jewelry industry as it does not tarnish as Ag does and has almost as high reflectivity for white light as Ag. Qualitative experiments have shown that very bright Rh deposits can be obtained from sulphate, fluosilicic, fluoboric, perchloric and oxalic baths. All can be regenerated by dissolving freshly prepared Rh hydroxide. The conditions of Rh deposition in these baths were determined qualitatively; it takes place with very high polarization so that at relatively low current density, metal deposition is accompanied by evolution of H. Tests are described in detail. 25 references. Ha (8d)

Chromium Plating Literature. XVII, XVIII, XIX, XX. L. H. Decke. *Platers' Guide,* Vol. 29, Sept. 1933, pages 10-11; Oct. 1933, pages 13-14; Nov. 1933, pages 13-14; Dec. 1933, pages 13-14. Deals with various aspects of the chromium plating industry. WHB (8d)

Studies on the Electrodeposition of Zinc (2). Y. Ogawa. *Journal Mining Institute of Japan,* Vol. 49, July 1933, pages 571-579. An apparatus was devised to indicate changes in current efficiency from the volume of evolved H_2 with a view to continuous observation. This was also used in determining the "critical current density" of metallic impurities. The latter varies much according to composition of the solution but is affected only slightly by increase in temperature except for a marked increase in case of Fe. The main factor in "deficiency" (100%—current efficiency) the simultaneous discharging of hydrogen ions. However, some of the hydrogen fails to form bubbles owing to some depolarization even in pure solutions, and a small error exists in taking the volume of hydrogen as a measure of "deficiency." The author found the apparatus to be useful at least in examining abrupt changes occurring during electro deposition. The impurities dealt with are Sb, As, Ni, Co, Fe, Cu, Ag, Cd and Mn. Even a trace of Sb results in a loose deposit and low current efficiency. Local corrosion of the deposited Zn is peculiar to Co, Ni and to some extent Cu. The coexistence of certain impurities such as Fe-Sb and Fe-As is especially harmful, others such as Mn-Sb and Mn-As need not be feared. Cd and Ag have no harmful effect on current efficiency nor on the physical nature of the deposit. The effect of addition agents on current efficiency varies greatly with pure and impure solutions and according to the impurities present. Some addition agents improve the structure of the deposit and also prevent excessive lowering of the current efficiency, such as may result from the presence of Sb, Co or Ni. YOp (8d)

A New Bath for the Direct Nickeling of Zinc. Geo. W. Nichols. *Metal Industry,* London, Vol. 43, Dec. 8, pages 566-568. Methods for Ni plating Zn are briefly reviewed. Displacement of Ni from its solutions by Zn is retarded by salts of hydroxy-acids, alcohols and dextrose; lactates are excellent. Good deposits of Ni on Zn can be obtained from solutions containing lactates; they do not have the yellow tone of those from baths containing citrate. Best deposits are obtained at a pH of 3.7-4.3. Greater acidity increases streaking and greater basicity decreases adhesion. Highly acid or ammoniacal baths may be buffered to the optimum pH by addition of rather large amounts of ammonium lactate without changing the plating characteristics of such baths. The ratio of lactate to Ni in the baths must be increased with increasing Ni concentration. 6 references. Hap (8d)

On the Polarization Potential in the Electrodeposition of Zinc from the Aqueous Solutions of Zinc Sulphate added some Colloidal Matters. T. Ishihara, T. Onoda & K. Umetu. *Kinzoku no Kenkyu,* Vol. 10, Aug. 1933, pages 365-382. The effect of addition agents on the polarization voltage was studied. Compositions of electrolytes and the method of measurement are same as in previous research (MA 176-Vol. 4). The single potential of zinc decreases with increasing amount of colloidal addition whereas the minimum overvoltage of oxygen and the decomposition voltage increase remarkably. In both cases the rate of change shows discontinuity at 0.1 g. colloid/l. Likewise cathodic polarization and anodic overvoltage increase with increasing amount of glue added with a discontinuity at 0.1 g./l., but they decrease with increasing amount of gelatine addition until 0.1 g./l., although an opposite tendency was observed above this value. The discontinuous change of all the above mentioned properties at $2N\,ZnSO_4$, which was observed when the concentration of $ZnSO_4$ was varied, the colloid constant being kept constant, became obscure when the amount of gelatine exceeded 0.1 g./l. The greater the amount of gelatine added, the greater is the effect of varying the composition of the solution upon the polarization voltage. The discontinuity at 0.1 g./l. is to be explained as being due to the change from sol to gel and the fall of single potential to the formation of some complex ion. YO (8d)

Specifications for electroplating (Les cahiers des charges pour la réception des dépots électrolytiques) Marcel Ballay. *Aciers Spéciaux, Métaux et Alliages,* Vol. 8, Aug. 1933, pages 240-257. Specifications for electroplating have been based on the characteristics of the deposits. The thickness of the plating can be determined by microscopic examination but more exactly by a solution method which measures the time required to dissolve the deposit. Many well known solvents for each type of electrolytic deposit are discussed. Methods in use in France for determining porosity, corrosion, hardness and brittleness are listed. GTM (8d)

Measurement of Throwing Power of Galvanoplastic Baths (Ueber die Messung der Tiefenwirkung galvanoplastischer Bäder) A. Onitchenko. *Zeitschrift für Elektrochemie,* Vol. 39, Oct. 1933, pages 815-818. The efficacy of an electroplating bath can be judged by its power to deposit metal in all cavities and depressions of the surface to be plated. Qualitative and quantitative methods to determine this are reviewed. The measurement of the throwing power of a Cr-plating bath as a function of H_2SO_4 concentration and current density is used as an illustration. Ha (8d)

Development of Electroplating in 1932 as Reflected by the German Patent Literature (Die Entwicklung der Galvanotechnik im Jahr 1932 an Hand der deutschen Patentliteratur) Kurt Nischk. *Oberflächentechnik,* Vol. 10, July 18, 1933, pages 167-168. Review of some conspicuous cases of cathodic cleaning in H_2SO_4 and HCl solution (D.R.P. 558022), improved Cr plating (550802, 559681, 563882, 557372, 550966, 557351, 551980), deposits of metals of the Pt group (549775, 564088), Cd plating (553613), and several processes of depositing Al together with other metals. Ha (8d)

Chromium Plating Finds New Applications in the Machine Shop. N. H. McKay & C. F. Bonnet. *Machinery,* N. Y., Vol. 39, May 1933, pages 576-579. Hardness tests made by holding a slow speed abrasive wheel against the surface to be tested at a constant pressure show Cr plate to be considerably harder than case-hardened steel, but that it varies widely in hardness with the method of deposition. Cr plating on soft metals such as Cu or mild steel gives excellent protection against abrasive wear. Cr has a very low coefficient of friction. It is resistant to almost all organic and inorganic compounds; HCl and H_2SO_4 are outstanding exceptions. Discusses several industrial applications. RHP (8d)

The Electrodeposition of Ternary Alloy of Cadmium, Zinc and Antimony. L. E. Stout & L. Goldstein. *Transactions Electrochemical Society,* Vol. 63, May 1933, pages 99-119; *Metal Cleaning & Finishing,* Vol. 5, June 1933, pages 257-260. Ternary alloys of Sb, Zn and Cd were deposited on the cathode by the authors in an electrolytic bath made of $Na_2Cd(CN)_4$, $Na_2Zn(CN)_4$, $KSbOC_4H_4O_6 \cdot \frac{1}{2}H_2O$, NaOH and 10% excess NaCN. Current density ranges 1.8 to 4 amp./ft.^{2}, and temperatures 20° to 65° C. Within these limits deposits are smooth, bright and easily polished. Deposition of Cd was found to be retarded unless a comparatively high concentration of Cd is present in the bath. An increase of current density at 20° C. produces an increase of Sb content in the deposit when the Cd and Zn contents of the bath are low, but it produces a decrease of Sb content in deposit when Cd and Zn in bath are high. Increasing current density at 20° C. increases Cd content of the deposit but decreases its Zn content. Temperature changes have similar effect on the composition of deposit as current density changes. Corrosion resistance of the alloy deposit is good but lower than that of pure Cd plating. LCP (8d)

The Electro-Deposition of Iron-Cobalt Alloys. II. S. Glasstone & J. C. Speakman. *Transactions Faraday Society,* Vol. 29, Feb. 1933, pages 426-429. Variation with current-density of compositions of alloys deposited from buffered solutions containing various proportions of ferrous and Co sulphates has been studied at temperatures of 50° and 90° C. Compositions of alloys tends towards a constant value as current-density is increased. This value appears to be independent of H^+ ion content of electrolyte. A comparison is made of 3 series of alloys which fall into the natural order Fe-Co, Fe-Ni and Co-Ni. Alloys deposited at both low and high current-density show gradations in properties in harmony with this order. WAT (8d)

Non-Metallic Coatings (8f)

Regarding the Ability of Paint to Cover Edges, and Its Consideration in the Testing of Paints (Ueber die Kantendeckfähigkeit und ihre Berücksichtigung bei der Prüfung von Anstrichmitteln) Fritz-Jürgen Peters. *Farbe und Lack,* Vol. 37, June 8, 1932, page 292. See *Metals & Alloys,* Vol. 4, Aug. 1933, page MA 271. EF (8f)

Corrosion Confusion (Korrosionswirrwarr) P. Nettmann. *Die Metallbörse,* Vol. 22, Oct. 19, 1932, pages 1341-1343. Removal of rust before applying paint coating is stressed and weather stability of paints involving a mixture of linseed and wood oil is emphasized. The drying times required by linseed oil paints are cut down due to treatment with chlorine-sulphur. 18 references. EF (8f)

Paint Protection of Gas Work Plant. D. Ritchie. *Gas Engineer,* Vol. 57, Sept. 1932, pages 501-502. See "Protection of Steel and Iron Structures in Connection with Gas Manufacturing Plant," *Metals & Alloys,* Vol. 4, Mar. 1933, page MA 59. WH (8f)

Protection of Aluminum and Light Metal Alloys by Organic Coatings (Über den Schutz von Aluminium und Leichtmetallegierungen durch organische Überzüge) F. J. Peters. *Die Metallbörse,* Vol. 22, Nov. 16, 1932, pages 1467-1470; Nov. 23, 1932, pages 1501-1502. Paint coatings on Fe are intended to protect the metal against oxidation, while a natural oxide film is encountered on light metals. The latter must be protected against the access of electrolytes. Light metals furthermore show a greater coefficient of expansion in comparison with Fe, thus limiting the number of primers. An organic coating (Jirotka, Bauer-Vogel, Bengough) guarantees an intimate contact with the light metal and furnishes an excellent means for additional paint coatings. A rough base for paint coatings can also be secured by application of pumice stone, emery paper, steel brushes or sand blasting. If the kind of work prohibits any mechanical treatment, washing with toluol or benzine is indispensable before painting. Pickling with calcined or caustic soda may work for pure Al but is often detrimental with reference to light metal alloys especially in the vicinity of rivets. Washing with HNO_3 should follow pickling. In contrast to Fe, the corrosion procedure in light metals is different in nature. When testing coatings on light metal alloys, checking on physical properties is necessary. Good results under service conditions were secured with pure linseed oil varnish as binding agent. Red lead, approved in the protection of Fe, is out of question in all cases where salt water or salty atmospheres prevail. It is also unsuitable as primer for lacquer. Best suited is a white lead-linseed oil coating. Zn white is not poisonous but subject to aging resulting in brittleness. Zn yellow, Ti white and Al bronze are also applicable. Fe oxide paints yielded favorable results if they did not include any water soluble salts. Oil lacquers rapidly lose their pliability due to aging. Nitro and acetyl cellulose lacquers are absolutely unsuitable. Experience gained on bitumen and tar are still contradictory. Bitumen including additions of Fe oxide or Al bronze are preferable. EF (8f)

Pantarol Luster Preservation (Pantarol-Glanzerhaltung) Walther Roethig. *Werft, Reederei und Hafen,* Vol. 14, Sept. 15, 1933, page 268. Note on tests performed by the Staatliche Materialprüfungsanstalt, Berlin, on a method of preserving the metallic luster of Cu, brass, Al, Fe, Cr-plated Fe and steel, according to which acid vapors, water spray and corrosive gases present over storage batteries and in boiler plants could not impair the metallic luster after 2 year's exposure. WH (8f)

Painting Technique (Anstrichtechnik) W. Adrian. *Zeitschrift Verein deutscher Ingenieure,* Vol. 77, Sept. 16, 1933, pages 998-1000. Methods and equipment for covering metals with non-metallic coatings by brushing, spraying, dipping; and means of derusting are discussed. Ha (8f)

The Electrolytic Oxidation Processes (Die elektrolytischen Oxydations verfahren) Hans Schmitt. *Oberflächentechnik,* Vol. 10, Sept. 5, 1933, pages 199-201. Recent methods to improve the surface of Al and its alloys are reviewed. They consist mostly in electrolytic oxidation produced by using the material as anode in an aqueous solution of certain acids whereby the Al is covered with a thin film of Al_2O_3. Oldest methods are the British (Bengough) and the German (Eloxal) processes. In the latter firm adhesion of the oxide film to the basic metal is obtained under the action of alternating current in oxalic acid solutions, while in the former the protective oxide layer is formed in chromic acid. Characteristics and uses of the principal methods are discussed. Eloxal process is best suited for Al alloys which are essentially free from Cu, Zn and other heavy metals. The corrosion-proof surface oxide layer is hard enough to render the material suitable for linings for tanks and apparatus for the chemical industry, dairy equipment, etc. Ha (8f)

Quantitative Determination of Adhesion of Paints (Zur quantitativen Ermittlung der Haftfestigkeit von Anstrichen) E. K. O. Schmidt. *Angewandte Chemie,* Vol. 46, Aug. 12, 1933, pages 525-529. See "Contribution to the Quantitative Determination of the Adherence Power of Paint Coatings on Metals," *Metals & Alloys,* Vol. 4, June 1933, page MA 199. Ha (8f)

Paint and Varnish Coatings on Aluminum and Its Alloys (Revêtements par peintures et vernis sur l'aluminium et ses alliages) H. Rabaté. *Revue de l'Aluminium et de ses Applications,* Vol. 10, July-Aug. 1933, pages 2133-2148. Very detailed and comprehensive study in three sections: 1. Preparation of surface of aluminum and its alloys prior to painting or plating. 2. Types of coatings: a) Formation of an oxide film. b) Electroplating. c) Metal spraying by Schoop process. d) Paints and varnishes. e) Fats and coatings of phenol condensation products. 3. Details on use, compositions and methods of applying paints and varnishes. AH (8f)

Protective Paint Made of Aluminum-Silicon Alloy (Rostschutzfarben aus einer Aluminium-Silizium Legierung) *Technische Blätter der deutschen Bergwerkszeitung,* Vol. 23, Oct. 15, 1933, page 582. Coating known commercially as "Sigal" protecting against attack of common and salty air, vapor, dust, gases and high temperatures is described. Sigal consists of a mixture of eutectic AlSi alloy (87% Al, 13% Si) and elementary Si with an oil binder. Preparation and use are discussed. GN (8f)

Art Painting on Aluminum (La peinture artistique sur aluminium) J. B. *Revue de l'aluminium et de ses applications,* Vol. 10, May-June 1933, pages 2099-2102. A fully-illustrated review of the technique of art painting on aluminum. AH (8f)

Factors Affecting the Porcelain Enameling of Cast Iron. *Enamelist,* Vol. 10, Sept. 1933, pages 9-12. The difficulties of enameling cast iron especially in small plants where technical control is not very strict are discussed. Greatest trouble usually arises from the adherence of fused molding sand to the surface to be enameled. Presence of bases in the molding sand renders it readily fusible to the surface, such castings are cleaned with difficulty by sand blasting. Slag behaves similarly; this must not be too high in lime to give a satisfactory, easily cleaned surface. Analyses of sands and slags which give good and bad results are given. Ha (8f)

Finish of 1933 Olds Improved by Rust-Proofing 44 Sheet Metal Parts. *Automotive Industries,* Vol. 69, July 29, 1933, pages 120-121. The Oldsmobile factory setup, which is one of the most efficient bonderizing plants, is given in detail. Each part is automatically conveyed through all the steps of the process. A total of 220 ft.^{2} per car is given the rust-proofing treatment. Each part is first cleaned in a washing machine, wiped dry with rags, dipped in alcohol, and passed through the bonderizing solution. It is next passed through hot-air ovens and wiped free of dust. This treatment offsets the effects of a humid, salty atmosphere. Parkerizing is a related rust-proofing process used rather commonly, in which the final application is linseed oil, to prevent moisture penetration to the underlying steel. DTR (8f)

Eloxal. *Aluminium,* Vol. 15, July 1933, pages 3-4. Properties and application of Eloxal, i.e., anodically oxidized Al, as protective coating for Al are briefly discussed. Ha (8f)

Aluminum Powder and Aluminum Paint (Aluminiumpulver und Aluminium farbe) *Aluminium,* Vol. 15, July 31, 1933, page 3. Description of preparation and properties. Ha (8f)

Durable Surface Coloring of Aluminum (Haltbare Oberflächenfärbung von Aluminium) *Aluminium,* Vol. 15, Sept. 15, 1933, pages 4-5. Durable surface coloring of anodically oxidized Al and Al-alloys can be obtained by using water-free fats, paraffin, wax, stearin, etc., as solvents for the dyes. Ha (8f)

Directions for Painting Aluminum (Richtlinien für das Aufbringen von Anstrichen auf Aluminium) *Aluminium,* Vol. 15, July 31, 1933, pages 2-3. To assure good adhesion of paints on Al surfaces they must be roughened first, by pickling or sandblasting, or a foundation layer of cellulose used. Methods are briefly described. Ha (8f)

Enamel as Protection against Corrosion (Email als Korrosionsschutz) Salmang. *Oberflächentechnik,* Vol. 9, Nov. 1, 1932, pages 221-222. See *Metals & Alloys,* Vol. 4, June 1933, page MA 201. Ha (8f)

Refinishing Motor Cars. Ralph Rand. *Industrial Finishing,* Vol. 8, July 1932, pages 27-28. Damaged automobile fenders are refinished skillfully so that the lacquered repair job blends into the surrounding baked surface. JN (8f)

Aluminum Paints in Power Plants (Aluminiumanstriche bei Kraftanlagen) M. Reichner. *Die Wärme,* Vol. 56, Feb. 11, 1933, page 91. Heat resistance and covering power of Al coatings are emphasized. Grease and rust removal are essential. When exposed to elevated temperatures, brushing until complete drying of the coating is recommended. Al powder and Na silicate show marked resistance towards atmospheric corrosion and surface injury. EF (8f)

Coloring of Copper and Iron in Saltmelts. (Färbung von Kupfer und Eisen in Salzschmelzen.) H. Krause. *Mitteilungen des Forschungsinstituts und Probieramts für Edelmetalle,* Vol. 6, Nov. 1932, pages 74-81; Feb. 1933, pages 114-122. Cu, Cu alloys and Fe can be more or less successfully colored in melts of pure salts or mixtures of salts. Clean, deep colors can not so much be obtained by longer time of leaving metal in molten salt but rather by a certain degree of overheating above melting point, even up to red heat. Most used salts are sodium nitrate, sodium nitrite, sodium hydroxide, sodium chromate, bichromate, perchlorate, perborate and peroxide, and nitrate, nitride, hydroxide, chromate, permanganate and bichromate of potassium. Choice among these is often determined by their prices which are tabulated. Colors obtained, mixtures of salts, time of immersion are described in detail in 25 tables for various products of Cu, Fe, and alloys of these. With sufficiently elevated temperature an immersion of ½ to 1 min. at utmost is quite sufficient to obtain a fine color; if immersion lasts too long durability of color is impaired. Hardened steel can, of course, not be colored in this manner as it loses its hardness. If Cu-plated articles are to be colored care must be taken that the plating is sufficiently thick so that it does not come off in the melt. Ha (8f)

New Process for Coloring Aluminum and Its Alloys. L. C. Pan. *Platers' Guide,* Vol. 29, Apr. 1933, pages 15-16. Coloral process for applying a variety of colored finishes to Al is outlined. It renders Al and its alloys practically immune from atmospheric corrosion, gives an attractive color and finish. It hardens the surface, renders a finish integral with the base and prevents peeling. The finish is unaffected by organic acids, soaps, fruit juices, foods, etc., and withstands temperatures up to 400° F. and higher. It is an electric insulator withstanding up to 170 volts. It is inexpensive and simple to operate, gives off no obnoxious fumes or odors and requires less than ½ hour to apply. No finishing or buffing is necessary. WHB (8f)

Investigations on Potassium-Permanganate-Copper Sulphate Pickle. (Untersuchungen über die Kalium-Permanganat-Kupfersulfatbeize.) H. Krause. *Oberflächentechnik,* Vol. 10, May 2, 1933, pages 103-106. Cu and Cu alloys are stained or colored by solutions the principal ingredients of which are $KMnO_4$ and $CuSO_4$. Additions of other metal sulphates does not bring about greatly differing colors. The staining velocity increases with $CuSO_4$ concentration and the color becomes deeper. Increasing $KMnO_4$ concentration has the same effect but only if the $CuSO_4$ concentration is increased correspondingly at the same time. The best brown color was obtained with 25 g./l.$CuSO_4$ and 5g./l.$KMnO_4$. The coloring adheres fairly well under mechanical stresses; when bending 180° the color adhered on the tensile side but came off on the compression side. See also *Metals & Alloys,* Vol. 4, Oct. 1933, page MA 325. Ha (8f)

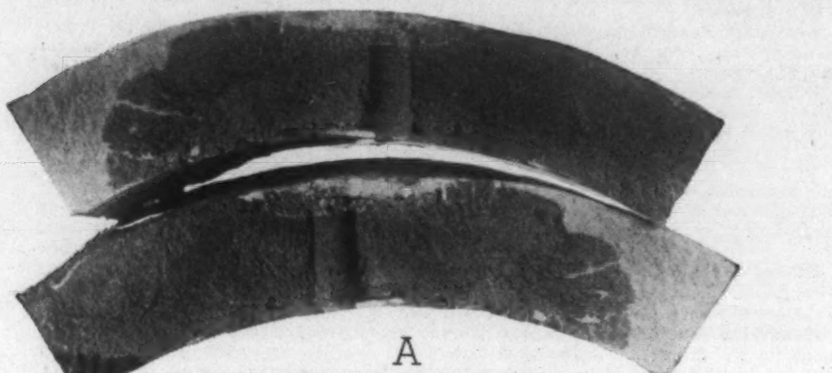
Practical Experience with Modern Paints for Metals with Oil, Nitrocellulose and Artificial Resin Base. (Erfahrungen aus der Praxis mit neuzeitlichen Anstrichstoffen für Metalle auf der Basis von Oelen, Nitrozellulosen und Kunstharzen) E. Krumbhaar. *Oberflächentechnik,* Vol. 10, July 4, 1933, page 157. Improper care in the preparation and application of rust-preventing coats of paints is usually the reason for failures; the ingredients of the paint must be selected according to weather influences and character of metal to be protected. Litharge is particularly proof against humidity. White lead, zinc white, iron oxide follow in the order named. The best binder is linseed oil. It should be treated in Al kettles. Nitrocellulose varnishes are very resistant against alkalies and acids, are very hard and must be ground; they are used principally in the automobile industry. Quick-drying paints have an artificial resin base, mostly phthalic acid anhydride-glycerine base. Ha (8f)

Electrolytic Oxidation of Aluminum. Eloxal Method (Elektrisk Oxydasjon av Aluminium. Eloxal-Methoden) J. Loewenthal. *Teknisk Ukeblad* Nov. 23, 1933, pages 561-564. A description of the Eloxal method for producing a protective oxide layer on Al and Al alloys; A.C. generally employed, with the aluminum to be treated and carbon as electrodes in rubber-lined sheet-iron cells; current requirement 3.5-4.5 kw.-hr./m.^{2}, 15°-30° C. A spray method for objects too large for immersion in bath is described. Alloys to be treated should preferably be free from Cu, Zn, and other heavy metals. Process is particularly suited to the Al-alloys, Pantal, Allantal, Duralumin K (Cu-free), Aldrey, K.S.-Seewasser, Magnalium, Silumin, V.L.W. 41. Results are given of comparative tests of physical properties and corrosion resistance of metals treated by several electrolytic oxidation methods, Eloxal method, Bengough method, and alumiting. BHS (8f)

Drying and Finishing in the Refrigerator Industry. C. F. Mayer. *Fuels & Furnaces,* Vol. 11, Mar.-Apr. 1933, pages 64-66. Enameling and drying furnaces, pickling and cleaning and spraying equipment are described. Ha (8f)

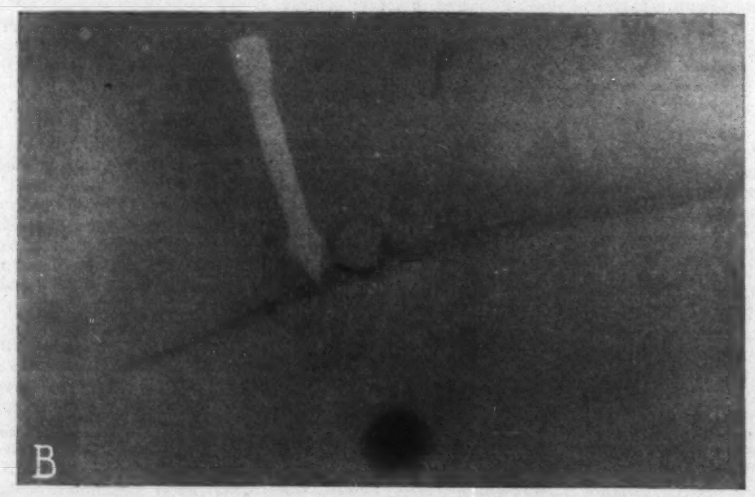
Utilization of Oxide Coatings on Aluminum produced Electrolytically (Eloxal Process) for Metal Coloring and for Galvanic Coatings (Verwendung von elektrochemisch hergestellten Oxydschichten auf Aluminium (Eloxalverfahren) für die Metallfärbung und für galvanische Ueberzüge) G. Buchner. *Oberflächentechnik,* Vol. 10, Oct. 24, 1933, pages 233-234. A table is given showing the different colors which can be obtained on Al and its alloys, silumin and lautal, by oxide layers produced electrolytically; gray, yellows, white and bluish tones can be produced by definite electrolyte and oxidation conditions. The oxide coating is a good absorbent for fat-soluble and water-soluble organic colors, especially tar derivatives. The article is suspended as anode in different organic solutions of which a few are described. A.c. or d.c. can be used, special effects can be obtained by polarized high-frequency current, that is, a.c. with a superimposed d.c. of such intensity that the resulting current is on only one side of the zero line. The oxidation process itself is very complicated, the final product being $Al(OH)_3$ as a surface coating. Ha (8f)

Blistering in Enamel Coatings of Cast Iron (Les Soufflures dans les Revetements d'Email de la Fonte) A. I. Krynitsky & W. N. Harrison. *Bulletin de l'Association Technique de Fonderie,* Special Number, July 1932, pages 90-91. See *Metals & Alloys,* Vol. 1, Sept. 1930, page 742. (8f)



A

(A) *Section of casting for high pres. sure steam line, confirming*
(B) *X-ray findings of crack at chaplet, indicating faulty casting technique.*



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TESTING (9)

Inspection & Defects, including X-Ray Inspection (9a)

C. S. BARRETT, SECTION EDITOR

Casting of Door Plates and Handles in Brass and German Silver. (Das Giessen von Türschildern und Drückern in Messing und Neusilber.) *Zeitschrift für die gesamte Giessereipraxis,* Vol. 54, June 4, 1933, pages 223-225. Particularly refers to defects apparent in making such castings and the remedies used. There are discussed defects due to incorrect gating (improper thickness and size of gates) formation of pipes and black spots which oftentimes become visible on door plates merely upon polishing. The causes of such stains are to be sought in the condition of the charge and the melting process, for instance, in contaminations by Fe bearing materials or a poor melting practice which favored the formation of oxides or increased the Cu content due to the Zn vaporizing. GN (9a)

Mechanical Failure of Boiler Plates. L. W. SCHUSTER. *Mechanical World & Engineering Record,* Vol. 93, July 14, 1933, page 673. Ill-fitting plates have to be distorted for riveting and are a common cause of failure. Heavy caulking often causes cracks. Lack of circularity and eccentrically loaded straps cause "breathing" which also leads to cracking. Kz (9a)

Study of Faults in the Foundry (Étude des Defauts de Fonderie) E. RONCERAY. *Revue de Fonderie Moderne,* Vol. 27, Dec. 10, 1933, pages 325-331. Causes of faulty castings in foundry operation are discussed; principal factors to be considered for successful casting are evacuation of gases from the mold, dislocation of the sand, incrustations of the mold, air entering the mold, pipes in the casting, gas inclusions, shrinking, penetration of metal into the sand, boiling of the metal, and shape of mold. Ha (9a)

Alternating Water-Pressure Tests on Welded Tanks (Weschsel-Wasserdruckversuche an geschweissten Behältern) M. ULRICH. *Zeitschrift Verein deutscher Ingenieure,* Vol. 77, Aug. 12, 1933, page 869. Results of alternating water-pressure tests show that the shape of the weld is of great importance and should be taken into account in the design. With certain restrictions the results obtained in alternating tensile tests can be transferred to welded joints. The test method is briefly described. Ha (9a)

Progress in Quantitative Chemical Analysis with X-Rays (Ein Fortschritt in der quantitätiven chemischen Analyse mit Röntgenstrahlen) F. VOGES. *Zeitschrift für Physik,* Vol. 80, Feb. 1933, pages 542-556. The X-ray emission and absorption methods for the analysis of chemical substances are reviewed and a recent development is described which gives results more quickly (in 2-3 hrs.) with an accuracy of a few tenths percent. The method is illustrated by applications to the determination of mixtures of Ag, Cu, Sn, Mo with monochromatic X-rays. Ha (9a)

Welding of Gray Cast Iron by Liquid Iron (Das Schweissen von Grauguss durch flüssiges Eisen) *Zeitschrift für die gesamte Giessereipraxis,* Vol. 54, Dec. 24, 1933, pages 523-525. Repair of defective cast iron parts by liquid iron requires great experience. The procedure is discussed, and the avoidance of thermal stresses is emphasized. Above all, parts to be thus repaired must be properly prepared. The reasons for failures are enumerated; in most cases the piece is not heated sufficiently or it is allowed to cool too rapidly. GN (9a)

Radium in the Service of the Metallurgist (Le Radium au Service du Metallurgiste) V. E. PULLIN. *L'Usine,* Sept. 14, 1933, page 25; *Metal Industry,* London, Vol. 42, Mar. 24, 1933, page 320; *Mechanical World & Engineering Record,* Vol. 93, Apr. 7, 1933, pages 340-344. See "Radium in Engineering Practice," *Metals & Alloys,* Vol. 4, Nov. 1933, page MA 348. Ha (9a)

Foundation of "X-Ray Testing Bureau at the Government Institute for Material Testing, Berlin-Dahlem" (Gründung der "Röntgenstelle beim staatlichen Materialprüfungsamt, Berlin-Dahlem") *Autogene Metallbearbeitung,* Vol. 26, Oct. 1, 1933, pages 300-301. The new institute is to carry out non-destructive tests for industry and government. Schedule of prices is given. Ha (9a)

X-Ray Inspection of Castings in the German Navy Yard (Röntgentechnische Prüfung von Gusstücken auf der Marinewerft) SCHATZMANN. *Werft, Reederei und Hafen,* Vol. 14, Aug. 1, 1933, pages 207-209. A discussion of the use of portable X-ray equipment of 220,000 volts (maximum) for the inspection of machinery and boilers. Typical X-ray radiograms are reproduced. WH (9a)

Measuring Stray Radiations During X-Ray Testing of Bridge Members (Strahlenmessungen bei Röntgenprufungen an Brückenteilen) W. ROSTECK. *Stahl und Eisen,* Vol. 53, Aug. 3, 1933, pages 801-803. Measurements indicated it was not necessary to reduce the voltage of the x-ray tube or take any other unusual precautions to protect the operators from stray radiations during the x-ray testing of steel bridges. SE (9a)

Special Equipment for Polishing and Buffing Large Parts to Reveal Flaws. H. H. HENSON. *Machinery,* N. Y., Vol. 39, Feb. 1933, page 425. Brief description with illustration of equipment for use on large parts, such as a locomotive rod. RHP (9a)

Chemical Analysis with X-rays. (Praktikum der chemischen Analyse mit Röntgenstrahlen.) G. V. HEVESY & E. ALEXANDER. Akademische Verlagsgesellschaft, Leipzig, 1933. Paper, 6¼x9¼ inches, 80 pages. Price 4.80 RM. The apparatus and technique of chemical analysis by X-rays were recently described by Hevesy in a book published in English, "Chemical Analysis by X-rays and Its Applications," McGraw-Hill (1932), reviewed in *Metals & Alloys,* page MA 174, June 1933. The monograph by Hevesy and Alexander published in German is essentially a condensation of this. They have omitted from the German edition the chapters on the chemical composition of the earth and the solar system, the properties of hafnium, and the age of the earth, and have condensed the other material from 120 to 80 pages. It is a business-like monograph, thoroughly organized under numbered headings, containing practically all of the material of the earlier book that has to do with the practice of the method. Very little new material has been added. The binding is inexpensive, the illustrations fewer than in the American book. The following tables are given (most of which are also given in the former volume): relative intensities of the K and L lines, absorption coefficients, emission lines and absorption edges tabulated in the order of increasing wavelength, excitation voltages for emission lines, the more important comparison lines, disturbing elements, wavelengths and corresponding reflection angles for rock salt, calcite and gypsum. Charles S. Barrett (9a)-**B-**

Determination of Defects in Work Pieces by Means of Mechanical Vibrations. (Fehlerbestimmung in Werkstücken mittels mechanischer Schwingungen.) *Technische Blätter der deutschen Bergwerkszeitung,* Vol. 23, June 4, 1933, page 317. Description of a new method to detect defects utilizing mechanical vibrations. The principle of the method is briefly: High frequency vibrations generated by an emitter outside the work piece are sent through the piece tested and recorded by a receiver. The energy of vibration decreases or is deflected when defects are present. Holes, cracks, etc., can thus be detected. GN (9a)

Extensive Study of Axle Failures. HANS DIERGARTEN. *Metal Progress,* Vol. 23, Jan. 1933, pages 48, 49, 58. R. Kühnel reported in *Glasers Annalen,* Feb. 15 and Mar. 1, 1932 an extensive study of axle failures from which he concluded that such failures were more often due to other causes than defective material. 3 types of fracture were noted: progressive fractures from bending, impact, and heat checks. Kühnel discusses these types of failure and the relation of various forms of overloading to such failure. There seems to be no particular virtue in any special composition when axles are properly designed, treated and machined. WLC (9a)

Physical & Mechanical Testing (9b)

W. A. TUCKER, SECTION EDITOR

Testing Sheet Metals (Prüfung von Feinblechen) M. V. Schwarz & K. Christoph. *Metallwirtschaft,* Vol. 12, Aug. 18, 1933, pages 476-477. For the testing of thin sheets which are to be cold worked the tensile, hardness and bend tests are not as satisfactory as a ductility test such as the Erichsen. The ducility, tensile strength, and elongation are related as follows:

$$\text{Ductility in mm.} - \sqrt{10 \times \text{thickness}} = \text{C.}$$
$$\text{Tensile strength}/4 + 2 \times \text{elongation} = \text{S.}$$

$C = \frac{S}{13} + 1.7$. The ductility of 8 materials was determined on an Erichsen apparatus and calculated from their tensile strength and elongation and the results agree fairly well. CEMp (9b)

Herbert Pendulum Hardness Tester. *Foundry Trade Journal,* Vol. 49, Aug. 31, 1933, page 123. Description of the "S.S." pendulum hardness tester which is a cheaper, simplified model of the standard Herbert instrument, manufactured by Edward G. Herbert, Limited, Levershulme, Manchester, Eng. OWEp (9b)

Simplified Pendulum Hardness Tester. *Engineer,* Vol. 156, July 21, 1933, page 68. Illustrates and briefly describes the "S.S." pendulum which consists of an arched weight of 4 kilos. resting on a steel ball of 1 mm. diameter, held in a chuck, so that the constants of the instrument and the readings obtained are identical with the standard Herbert "pendulum" hardness tester. The makers are E. C. Herbert, Ltd., Manchester. LFMp (9b)

Suitability of Notch-Impact Test for Testing of Welded Joints (Eignung des Kerbschlagversuches zur Prüfung von Schweissverbindungen) P. Bardtke & A. Matting. *Autogene Metallbearbeitung,* Vol. 26, Sept. 15, 1933, pages 279-282; Oct. 1, 1933, pages 292-293. Notch-impact tests were carried out under various conditions and shapes of samples. Although this test does not give values which permit a direct conclusion or use as to design of a structure it does give information about the important property of deformability of the material. This is especially important as local stresses of particular high value cannot always be avoided in welding but which are of no consequence if the weld has a good deformability enabling it to flow at the local stress so that the latter is distributed more evenly. The most suitable form for a sample for notch-impact tests seems to be the short form as used at present in German testing. Standardization of this test is advocated. Ha (9b)

The Notch Impact Test for Mild Steel (Ueber die Kerbschlagprobe bei Schweissstahl) E. Schneider. *Mitteilungen aus den Forschungsanstalten des GHH-Konzerns,* Vol. 2, Mar. 1933, pages 99-107. It is pointed out that the notch impact test for mild steel is influenced by the mechanical preparation of the samples and by the anisotropy of mild steel which is caused by a tier-like arrangement of slag-particles between the sheet billets. A new method of rolling of steel is described which eliminates these slag arrangements so that the steel obtains a good uniform structure for all usual mechanical stresses. The steels made in this manner showed a better notch impact strength than those made in the old way. Definite suggestions as to the best arrangement of notch impact tests and arrangement of the notch in the sample are derived. Ha (9b)

The Mechanical Testing of Metals. The Transverse Test. T. F. Russell. *Metal Industry,* London, Vol. 43, Sept. 1, 1933, pages 191-193. Nature of and procedure at bending test and calculating stresses from deflection are discussed and machines for transverse testing described. Particular reference is made to transverse testing of cast iron. Ha (9b)

Determination of Stress Distribution in Construction Parts by Measurements of Elongation (Die Ermittlung der Spannungsverteilung in Konstruktionsteilen durch Dehnungsmessungen) F. Roetscher. *Zeitschrift Verein deutscher Ingenieure,* Vol. 77, Apr. 8, 1933, pages 373-378. The calculation of stresses as they actually exist in structural parts by measuring elongations is explained, measuring instruments and methods described. Several examples of crane hooks, flanges, T-pipes, etc., illustrate the procedure. Ha (9b)

A New Method for Measuring Internal Stresses, and its Results (Neue Verfahren zum Messen von inneren Spannungen und deren Ergebnisse) A. Sonderegger. *Zeitschrift für Schweisstechnik,* Vol. 23, Aug. 1933, pages 206-210. Describes the process used in the Maybach motor works. The test method is a combination of the varnished surface method and a specially devised instrument for measuring internal stress. Curves report results of tests. RRS (9b)

Depth of the Groove in the Test-bar for Resilience Tests (La profondita dell'intaglio nella barretta per prove di resilienza) A. Steccanella. *La Metallurgia Italiana,* Vol. 25, Sept. 1933, pages 673-682. Confirms previous work showing that the Mesnager test-bar (10 10 55 mm.) with a 2 mm. groove gives the most consistent results, and that it should be adopted as the international standard. AWC (9b)

Testing of Light Metals for Pistons (Prüfung von Leichtkolben baustoffen) M. v. Schwarz & P. Sommer. *Automobiltechnische Zeitschrift,* Vol. 36, July 10, 1933, pages 341-342. Friction resistance and wear are the most important properties for materials used for pistons. Pressure, condition of surface, temperature and quality of lubrication determine, for the same velocity, the friction. Testing machines for these quantities are described. It can be concluded that temperature has only a small influence, especially a low load; the friction increases considerably with increasing perpendicular pressure and recrystallization will take place. Heat conductivity determines greatly the suitability of a light metal for pistons as it determines the cooling. Test results with several Al-Cu alloys are described. Ha (9b)

A Graphical Representation of Two-Dimensional Stress Distributions. V. Tesar. *Journal Franklin Institute,* Vol. 216, Aug. 1933, pages 217-224. Originally published in Le Génie Civil, June 20, 1931, and the condensed translation given here by A. Solakian, Columbia University. Graphical methods of representing the results have been found to be more demonstrative than a mere tabulation of values. A complete portrayal of any stress distribution is given by 2 diagrams. One of these is the usual isostatic network and the other is a system of curves representing the magnitudes of forces normal to the isostatics. DTR (9b)

Modern Material Testing in Working Doublé (Moderne Materialprüfung im Dienste der Doubléverarbeitung) W. Radecker. *Deutsche Goldschmiedezeitung,* Vol. 36, Oct. 7, 1933, pages 438-440. Describes methods of mechanical and microscopic testing, as Erichsen cupping test, hardness test, tensile test, microscopic examination, etc. GN (9b)

Clamping Head of a Flat Sample Bar for Tensile Tests (Testa die Afferraggio di Provette Piatte per Prove a Tensione di Lamiere) C. Peona. *L'Industria Meccanica,* Vol. 15, Apr. 1933, pages 305-310. An analytical study of the stress distribution in a flat bar under tensile stress leads to a more favorable shape of the head of the sample for clamping and pulling which gives greater security against breaking. Ha (9b)

Model Testing as Applied to Strength of Materials R. E. Peterson. *Transactions American Society of Mechanical Engineers,* Vol. 55, *Applied Mechanics,* Apr.-June 1933, pages 79-85. The use of models and the application of results obtained with models to actual cases is discussed; the law of similarity of Barba and Kick can be applied with certain reservations. Where stress concentration is not present the results are usually not dependent on size. With stress concentration, however, smaller specimens tend in general to give higher values. In such cases, also, the effect of time may be important. Effect of size in tension, fatigue and impact tests is considered in detail. 33 references. Ha (9b)

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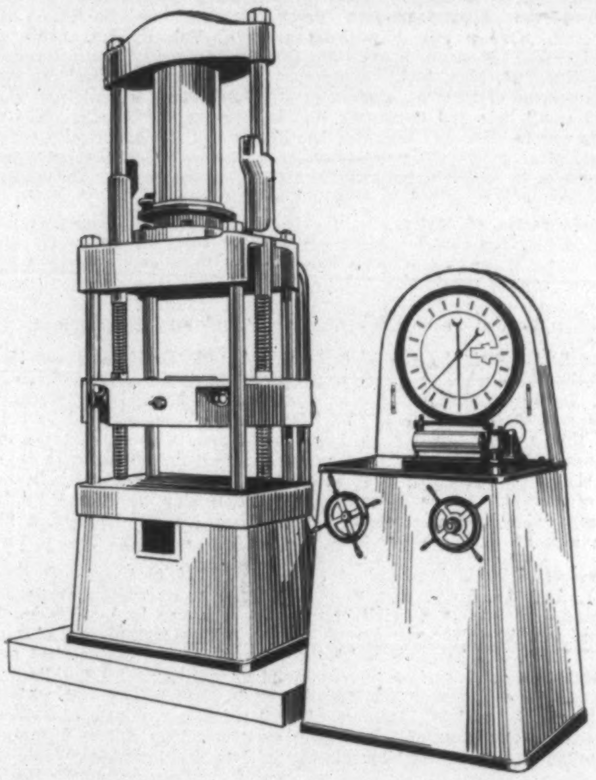

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Recording of Rail Stresses and High-Speed Trains (Aufzeichunung der Schienenbeanspruchung unter schnellfahrenden Zügen) H. THOMA. *Zeitschrift Verein deutscher Ingenieure,* Vol. 77, Aug. 12, 1933, pages 873-878. A condenser measuring instrument and the manner of application is described. Results of measurements are reproduced in records. 9 references. Ha (9b)

Testing Methods for Welds (Prüfverfahren für Schweissungen) G. FIEK. *Zeitschrift Verein deutscher Ingenieure,* Vol. 77, Sept. 16, 1933, pages 1005-1008. The various methods of testing the quality of welds are reviewed and the present status of standardization is discussed. Folding or bending test, tensile test, notch-impact test, hardness test and non-destructive tests and the preparation of samples for each kind of testing are described. Ha (9b)

Determination of Inherent Stresses by Measuring Deformations of Drilled Holes (Ermittlung von Eigenspannungen durch Messung von Bohrloch-Verformungen) J. MATHER. *Archiv für Eisenhüttenwesen.* Vol. 6, Jan. 1933, pages 277-281; *Technical Memorandum, National Advisory Committee for Aeronautics,* No. 702, Mar. 1933, 8 pages. An effective method for the detection and measurement of inherent stresses in structural parts or buildings was found by drilling a small hole and measuring the deformation which takes place around the hole; this can be done by measuring the distance of 2 diametrically opposed points before and after drilling by a dilatometer. A test on a broad flange girder revealed tensile stresses in the web, compression stresses in the flanges. The whole procedure with instruments is described in detail. 6 references. HWG + Ha (9b)

The Deformation of Matter. R. L. PEEK. *Bell Laboratories Record,* Vol. 11, Mar. 1933, pages 190-194. The deformation of a material which it experiences under the action of given forces is the basis of all physical testing. The 2 groups of testing methods are testing under conditions simulating those existing in service, and testing to evaluate certain physical constants to predict the behavior. The stress-strain relations in the different kinds of tests are explained. Ha (9b)

Judging Boiler Plate by the Nick-Bend Test (Die Beurteilung von Kesselblechen durch die Kerbbiegprobe) A. THUM & H. HOLDT. *Stahl und Eisen,* Vol. 53, May 11, 1933, pages 505-508. 8 samples of low-C boiler plate, 1 of Si—killed the rest of rimming steel, 15 to 50 mm. thick, were tested by the nick-bend test. In this a longitudinal section 60 to 80 mm. wide is nicked across with a chisel, broken by bending, and the fracture observed; the fracture may be crystalline, fibrous, slaty, or laminated. The nick-bend test gave no sure indication of the quality of the plate since a crystalline fracture may be caused by low testing temperature and by the thickness of the plate. In general, however, a fibrous fracture is a sign of good quality. SE (9b)

The Testing of Steel. *Journal of Commerce (Shipbuilding & Engineering Edition),* Aug. 17, 1933, page 2. A series of comparative tests were carried out on ship plate, using a small test piece, 8″ parallel, 1½″ wide, ½″ thick, and having a width-thickness ratio of 3, and a large test piece 72″ parallel, 28″ wide, ½″ thick, and having a width-thickness ratio of 56. The yield point of the smaller test piece was 39,400 lbs./in.^{2} and of the larger 36,800 lbs./in.^{2}, while the ultimate strengths were 62,500 lbs. and 61,600 lbs./in.^{2} with percentage elongations of 28.9 and 26.1 respectively and reductions of area of 5.15 and 34%, showing that steel plates built into large structures have a less degree of ductility before fracture than is revealed by existing steel testing technique. JWD (9b)

Impact Test of Cast Irons (L'Essai de Choc des Fontes) H. THYSSEN & C. BARON. *La Fonderie Belge,* Vol. 2, Nov. 1932, pages 207-209. Charpy tests performed on small test bars cut in castings or in coupons attached on those castings were made with a more sensitive tester, a 1 kg drop hammer. Questions studied are (1) Is it preferable to groove test pieces? Results show that it is not useful, cutting effect of graphite flakes being sufficient. Any groove lessens useful section of test pieces and consequently reduces accuracy of test. (2) Are impact tests on ungrooved test pieces sufficiently regular? Study shows that accuracy and regularity on samples cut in homogeneous cast Fe castings without foundry defects are as good as for steel. Impact tests can be applied to cast Fe if reasonable cares are taken to prevent causes of errors. (3) Do impact tests give anything new? Results of tests made on a series of plain cast Fe and a series of alloy cast Fe plotted diagramatically show the impact curve parallel to transverse strength curve. General conclusions are: Impact tests classify cast Fe in same order as do transverse tests, only one of the two tests is necessary. The latter is preferred. Although impact is much affected by local foundry defects it can be of much value in investigation work on alloy cast Fe. FR (9b)

New Principles for Making and Testing Beaded Areas of Boiler Tubes (Neuere Gesichtspunkte für die Herstellung und Prüfung von Einwalzstellen) W. RUTTMANN. *Schriften der Hessischen Hochschulen,* 1933, No. 2, pages 51-57. Paper before Werkstofftechnisches Kolloquium der Staatlichen Materialprüfungsanstalt an der Technischen Hochschule Darmstadt, June 24, 1933. Author gives the results of further investigations on the problem, see *Metals & Alloys,* Vol. 4, Sept. 1933, page MA 286. Practical tests of beading boiler tubes must study in particular the fit attained by beading. Best results were obtained in widening by beading the tubes for about .7-1.2% while the play of the tube amounted to .8 mm. A decrease in the fatigue properties of such beaded areas by about 35-40% resulted when the play as well as the widening increased over 1.6%. For these widening tests of boiler tubes the Krager beading machine was used. It was found that for proper beading and for attaining a tight fit a certain pressure of the beading mandrel and certain number of revolutions must be observed in order to attain the desired widening of the boiler ends. The speed of beading affects the fit in that a higher speed is better than a slower one. Therefore, data on the widening of boiler tubes are of value only when the type of beading and the beading speed are stated. The results of static bending tests on beaded areas are reported. The stress-elongation curves of beaded areas taken in these tests show that at a certain load when the curves deviated more or less suddenly from the straight course, the tube slipped in the beaded area. This slip is no plastic deformation of the tube but a permanent distortion of the tube in its seat in the boiler. However, by resonance oscillations the tube returns almost completely to the location it possessed before the static distortion. Furthermore, it was found that beaded areas which have absolutely tight fits become loose as soon as the slip limit is passed. The results of these tests are in accordance with practical experience. GN (9b)

Measurement of Abrasion Resistance of Hard Bodies (Mesure de l'usure au frottement des pièces à surface dure) N. SAWIN. *Génie Civil,* Vol. 104, Sept. 1933, pages 254-257, 278-280. **Wear of Hard Metallic Surfaces.** *American Machinist,* Vol. 77, Aug. 2, 1933, pages 496-499. Abrasion resistance is determined in a machine in which a vertical Widia wheel 25-30 mm. diameter rotating at 600 RPM abrades the surface which is cooled by lubricants. Means are provided for loading the wheel. After predetermined number of revolutions the dimensions of abrasion channel are read with microscope arranged as in Vickers hardness machine. Minute description of the influence of every factor entering the design and functioning of the apparatus is given. Measuring error was found to be ±5%. Results check well those of French and Hershman machine. Metals can be arranged in 4 groups: W and Ti carbide alloys; nitrided, chromium plated, quenched special steels with 5-15% Co and hard Co alloys; high speed steel; tool steel and quenched carburized steel. Their relative resistance to abrasion is: 1 : 15 : 25 : 40. On drawing tool steel within 100°-400°C. wear resistance and hardness decrease. Minimum wear corresponds to the maximum hardness obtained on 100°C. draw. In the interval 220°-280°C. wear does not vary, hardness drops from 750 to 600. Annealed steel has the same wear resistance as drawn at 400°C. Tool steel cooled with soda solution gave the smallest wear after drawing at 300°C. Hardness does not characterize wear resistance unless the same materials are compared. JDG + Ha (9b)

Fatigue Testing (9c)

The abstracts appearing under this heading are prepared in co-operation with the A.S.T.M. Research Committee on Fatigue of Metals.

H. F. MOORE, SECTION EDITOR

Effect of Shape on the Fatigue Properties of Construction Parts (Der Einfluss der Formgebung auf die Dauerhaltbarkeit von Konstruktionsteilen) A. THUM. *Schriften der Hessischen Hochschulen,* 1933, No. 2, pages 31-37. Paper before Werkstofftechnisches Kolloquium der Staatlichen Materialprüfungsanstalt an der Technischen Hochschule Darmstadt, June 24, 1933. There are 3 different possibilities of decreasing the dangerous notch effect in fatigue tests (1) protection of the endangered part by compressive initial stressing, (2) use of materials which are particularly insensitive to the notch effect, (3) suitable shape of the construction by decreasing the notch effect. The paper particularly deals with the latter point. To attain this end arrangement and shape of the entire construction should be so made as to attain rather uniform stress distribution in the whole piece so that the stresses flow without sharp interruption. To lessen the stress in endangered parts stress relieve notches may be arranged. Proper shape of fillets plays an important role. Investigations on welded parts by Lipp prove, for instance, that the quality of the weld seam may be less important than its cross-section. Examples are then discussed to prove the rules developed by the author for proper shaping of construction parts. GN (9c)

The Fatigue of Metals. Its Nature and Significance. H. F. MOORE. *Transactions American Society of Mechanical Engineers,* Vol. 55, Applied Mechanics Section, Jan.-Mar. 1933, pages 15-18. The essential feature of fatigue failure in metals is a spreading crack; study of fatigue failures in single crystals of metal indicate that such cracks frequently start by slip along planes of atomic weakness. Mathematical methods of elasticity do not always give reliable results when applied to inhomogeneous metals. Relation of atomic strength to the strength of a multi grained piece of metal is discussed with the view of finding a more reliable method to determine the occurrence of failure by cracks. 9 references. Ha (9c)

Influence of Places where Pieces are Held or Forces Attack on the Endurance Strength of Constructions (Der Einfluss von Einspann und Kraftangriffstellen auf die Dauerhaltbarkeit der Konstruktionen) A. THUM & F. WUNDERLICH. *Zeitschrift Verein deutscher Ingenieure,* Vol. 77, Aug. 5, 1933, pages 851-853. It is pointed out that the safety of a construction or a part is greatly reduced by additional stresses on places where they are held, gripped or where other forces attack. Endurance strength can be improved by giving such parts proper shape and pre-impressed stresses, by case-hardening or especially by nitriding. These factors were investigated by elastic-optical experiments and the path of the stresses determined in order to find the best shape of piece for a given case. Ha (9c)

Endurance Diagrams (Dauerfestigkeits Schaubilder) Arbeitsblatt No. 1, Fachausschuss für Maschinenelemente beim V.D.I. Supplement to *Zeitschrift Verein deutscher Ingenieure,* Oct. 21, 1933, 4 pages. Brief summary of endurance of steel from standpoint of the engineer and machine builder, with special emphasis on effect of surface finish, notches, and corrosion. HWG (9c)

The Royal Society Conversazione. *Engineering,* Vol. 135, May 26, 1933, pages 566-568. A brief description of the exhibits shown before the Royal Society, London, May 17, 1933. Sir Robert Hadfield's metallurgical exhibit included a number of tested specimens showing the effect of the temperature of liquid hydrogen on the tensile properties of iron, ferrous alloys, Cu, Ni, and some nonferrous alloys. Dr. W. H. Hatfield supervised a demonstration of the maintenance of a constant temperature in long time tensile tests at elevated temperatures. A new form of fatigue testing machine for wire was shown jointly by J. D. Brunton, B. P. Haigh, and T. S. Robertson. An illustration is given of this machine. LFM (9c)

Fatigue of Mild Steel. *Engineer,* Vol. 153, Mar. 4, 1932, pages 255-257. Reprint of a report of a Committee of the North-East Coast Institution of Engineers and Shipbuilders on a definition of fatigue. Report briefly discusses following: former meaning of fatigue, modern research on causes of failure under repeated stresses, effect of repeated stresses on crystalline structure, effect of small flaws on stress distribution, characteristics of fracture under repeated stresses, relation between limited stresses for repeated applications and other mechanical tests, the present meaning of fatigue, and a suggested definition of fatigue. See also editorial comment on this report on page 263. LFM (9c)

Combating Corrosion-Fatigue (Zur Bekämpfung des Korrosionsdauerbruches) H. BUCHHOLTZ & K. KREKELER. *Stahl und Eisen,* June 29, 1933, pages 671-674. A brief correlated abstract of corrosion-fatigue of steel. Contains a table of corrosion-fatigue results of various investigators giving the protection against water corrosion and fatigue of different protective agents as follows:

Steel	Protector	*Degree of Protection
0.47% C; annealed	sherardizing	59
0.47% C; annealed	galvanizing	100
0.47% C; annealed	Cd coating	62
0.70% C; annealed	sherardizing	67
0.70% C; annealed	Cd coating	67
Nitriding steel	nitriding	100
0.33% C; annealed	rosin coating	100
0.35% C; annealed	addition of 0.02% $Na_2 Cr_2 O_7$ to water	100

*Approximate ratio of endurance limit with corrosion plus protection, to endurance limit without protection and without corrosion.

The addition of about 1% of a soluble oil to the water also gave a protection of between 48-70% to various steels. SE (9c)

Fatigue testing of Fusion Welded Seams (Ueber die Dauerprobung autogen geschweisste Nähte) OTTO GREGER. *Zeitschrift für Schweisstechnik,* Vol. 23, June 1933, pages 161-167; July 1933, pages 180-186. Illustrated description of the test apparatus, the test pieces, and the method. Results of static and dynamic tests. RRS (9c)

Fatigue and Corrosion (Ermüdung und Korrosion) K. LAUTE. *Paper Third Corrosion Congress Verein deutscher Ingenieure, Verein deutscher Eisenhüttenleute, Deutsche Gesellschaft für Metallkunde and Verein deutscher Chemiker, Nov. 14, 1933, Berlin.* Mimeographed report, page 1. Author discusses in general problems concerning fatigue and corrosion. Fatigue properties of metallic materials are considerably affected by the presence of pores and foreign inclusions as well as by the surface condition of the material. Thus the fatigue limit of soldered and welded parts is correspondingly lower than that of the homogeneous base metal. To a similar extent surface changes due to corrosion impair the fatigue properties. This decrease is particularly large when corrosion and fatigue act simultaneously. Corrosion-fatigue is not a pure surface effect. Of special interest is the fatigue behavior of welded and soldered materials under or without corrosion. Tests carried on by Staatliches Materialprüfungsamt Berlin-Dahlem show remarkable differences of behavior in pure fatigue and corrosion-fatigue tests. It results that welding pores do not decrease the corrosion-fatigue properties still more provided the fatigue tests are extended for a sufficiently long time. GN (9c)

Fatigue Properties of Bolts and Nuts in Dependence on the Shape of the Nut (Die Dauerfestigkeit der Schraube in Abhängigkeit von der Mutterform) H. WIEGAND. *Schriften der Hessischen Hochschulen,* 1933, No. 2, pages 67-72. Paper before Werkstofftechnisches Kolloquium der Staatlichen Materialprüfungsanstalt an der Technischen Hochschule Darmstadt, June 24, 1933. A joint by bolt and nut is a typical example that, besides material properties, mechanical working and thermal treatment, the shape is of decisive importance for the fatigue properties of a constructional element. Stresses occurring in bolts and nuts are considered and the possibilities of decreasing them are considered. These are: (1) proper material, (2) suitable thread making and heat treatment, (3) suitable shape of bolt (well rounded transition between head and shaft, tapering the bolt shaft upon shock, bending loads and large elongation), (4) suitable shape of nut and suitable installation, (5) suitable devices for avoidance of unloosening of nut and maintenance of initial stress. The considerations of the author refer in particular to the latter 2 points. The results of fatigue tests on various types of bolts and nuts under different conditions are given. From these tests it results that the fatigue properties are considerably impaired when the initial stress fails due to loosening of the nut or other conditions. In all cases the fatigue properties of bolt and nut joints could be improved by observing a favorable flow of force between bolt and nut. GN (9c)

On the Effect of Clamped Areas, Force Attack and Hub Seats on the Fatigue Properties of Constructions (Der Einfluss von Einspann-, Kraftengriffs-, und Nabensitzstellen auf die Dauerhaltbarkeit der Konstruktionen) F. WUNDERLICH. *Schriften der Hessischen Hochschulen,* 1933, No. 2, pages 45-50. Paper before Werkstofftechnisches Kolloquium der Staatlichen Materialprüfungsanstalt an der Technischen Hochschule Darmstadt, June 24, 1933. Factors affecting the fatigue properties of clamped constructions are discussed. The pressure plays a decisive role in clamping. The fatigue limit first decreases with increasing pressure on the face to then reach a constant value. Further the material is of importance. The harder the material the lower the fatigue limit. Since the materials possess a different sensitivity to notch effects the decrease of the fatigue limit is to be expected also in clamping effects. The various possibilities of increasing the fatigue limit at clamp effects are discussed: (1) suitable shape, (2) compressive initial stressing, (3) combination of (1) and (2), (4) case carburizing and nitriding. Results obtained by these methods are described. The considerations go to show that in machinery construction it is of great importance to properly machine the parts and care for proper installation, not only from the viewpoint of tight fit and interchangeability, but also from the fatigue point of view. Practical examples are considered illustrating this. GN (9c)

The Fatigue Properties of Light Metals and Alloys. R. L. TEMPLIN. *Preprint No. 35 American Society for Testing Materials,* June 1933, 17 pages. A review of the various types of fatigue tests made on light metals and alloys together with a description of types of machines and apparatus used in tests made by the Aluminum Company of America. A new design of direct tension-compression fatigue machine is described and a brief description of the high-speed vibrating-wire type is also given. A considerable amount of static and fatigue data is given for nearly all the commercial light alloys of aluminum, both wrought and cast, and for several magnesium-base alloys. The relation between endurance limit and tensile strength, the effects of cold working and heat treatment on the endurance limit and the effects of notches on the fatigue strength of certain alloys are discussed. Results obtained on different forms of product by means of different types of specimen and by various investigators are shown to give concordant results provided the tests are carried out to a sufficiently large number of cycles. That the number of cycles of stress required to define the endurance limits of most light alloys is of the order 500 million is shown by comparison with foreign laboratory test results, which generally show much higher endurance limits. Curves are given illustrating how misleading results may be obtained from tests not run a sufficiently large number of cycles. VVK (9c)

Fatigue Fracture by Corrosion (Dauerbruch durch Korrosion) P. NETTMANN. *Automobiltechnische Zeitschrift,* Vol. 36, Sept. 10, 1933, pages 438-439; Sept. 25, 1933, pages 459-460. Corrosion fatigue or fatigue fracture occurs when materials are working moistened by water and simultaneously subject to alternating stresses. Salt water increases the effect, but certain additions to the salt water can reduce fatigue. Alloyed steels behave better than unalloyed steels with few exceptions. Relation between coldness and corrosion of cylinder walls was investigated: below 90° C. of the cylinder walls corrosion increases considerably; this depends to a certain extent also on the pH-value of the oils, vapors, etc., coming into contact with the walls. With pH from 4 to 10 neutrality exists and the temperature alone is important. Work of several institutes with regard to this subject is briefly reviewed. Part II. Fatigue of engine cylinder materials is investigated on the theory of lubrication developed by Parish and Cammen. Corrosion by fatigue is due to the molecular actions of the lubricant upon the cylinder walls. The entrance of fuel and water into the oil gives mixtures which lead to destruction of motor and bearing. Emulsion of oil with water up to 15% can be considered harmless. The effect of these facts on the operation of automobiles is discussed. Ha (9c)

The Civil Engineers' Conversazione. *Engineer,* Vol. 155, June 23, 1933, page 620; *Engineering,* Vol. 135, June 23, 1933, pages 685-687. Illustrated article describing exhibits shown at a meeting of the Institution of Civil Engineers, June 14, 1933. B. P. Haigh showed his testing machine for wire and F. Bacon exhibited the results of his studies in the propagation of creeping cracks in metals. LFM (9c)

Interpretation and Elimination of Corrosion Fatigue of Steel (Erklärung und Bekämpfung der Korrosionsermüdung von Stahl) L. SCHNEIDER. *Die Naturwissenschaften,* Vol. 20, Dec. 9, 1932, pages 909-910. Due to the roughness of the metallic surface which increases the geometric size 2 or 3 times, submicroscopic cracks are opened and closed by external stresses. In the presence of corroding agents, the latter are sucked in and pressed out continuously resulting in a loss of fatigue resistance of 9.8-16.9 kg./mm.^{2} in plain C steels and 8.8-21 kg./mm.^{2} in alloy steels. By applying a pre-stress, say rolling, these cracks are closed. Thus the fatigue resistance could be raised from 26 to 29 kg./mm.^{2} or 11.5% and in the presence of corroding media from 10 to 15 kg./mm.^{2} or by 50% according to Thum and Ochs, Darmstadt. EF (9c)

Fatigue Testing with Simple Test Specimens. HAAKON STYRI. *Metals & Alloys,* Vol. 4, Sept. 1933, pages 141-142. In an effort to arrive at a less expensive specimen for fatigue testing the author has produced a machine for such test using a cylindrical ring specimen loaded radially at three points 120° apart. The machine and specimen finish required are described and results given for 1% C, 1½% Cr ball bearing steel in various conditions of heat treatment. The author cites certain advantages of the method particularly in evaluating the quality of steel for bearing races. WLC (9c)

Standardization of the Alternating Bend Test for Thin Mild Steel Sheets. J. C. GODSELL. *Sheet Metal Industries,* Vol. 7, June 1933, pages 75-77. A paper before the Swansea Technical College Metallurgical Society. The paper is intended to amplify work done by the author which showed that the 2 factors which vitally affect bend test results are thickness of material, and radius of bend. Two formulae are given which indicate the quality of a material, other factors remaining constant. AWM (9c)

Endurance of Metal in Corrosive Surroundings. T. S. FULLER. *Metal Progress,* Vol. 23, June, 1933, pages 23-26. The progress of corrosion fatigue studies is traced. The assembly used at General Electric Co. for the testing of endurance of steel in steam, is given. A stress-number of applications for failure graph shows the typical corrosion fatigue curve. McAdam's results on the corrosion fatigue of Cr-Fe alloys are tabulated. Previously published work and some of the definitions in this field are discussed. WLC (9c)

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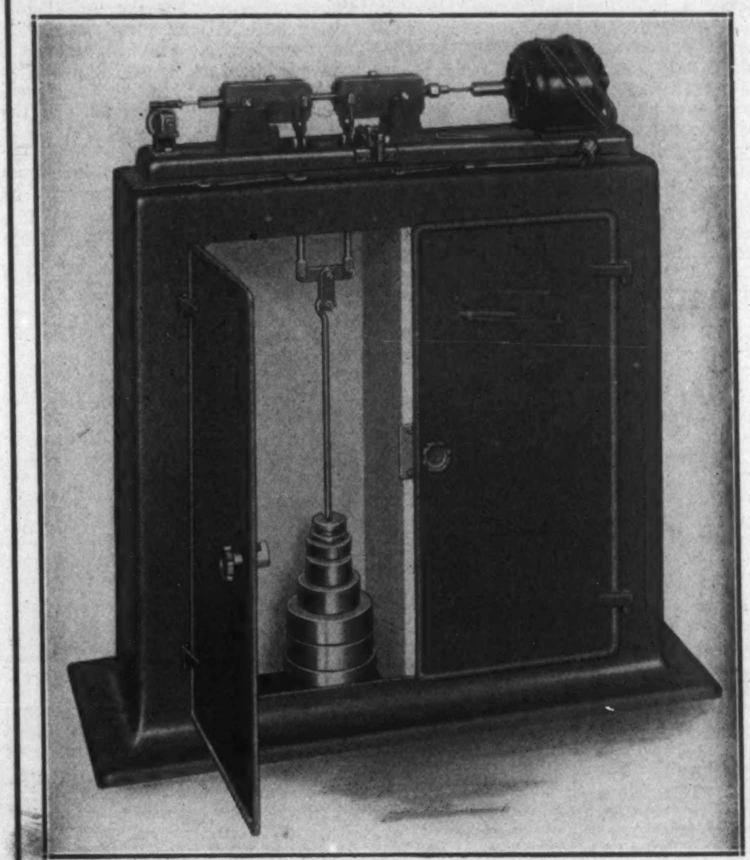

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Influence of Corrosion on Endurance of Steels and Nickel (Der Einfluss der Korrosion auf die Biegungsschwingungsfestigkeit von Stählen und Reinnickel) O. Behrens. *Mitteilungen des Wöhler-Instituts,* No. 15, 1933. 73 pages, 38 figures. Two carbon steels, as rolled, three heat-treated alloy steels, all of 0.30% C, one with 3% Ni, another with 4½% Ni, 1¼% Cr, the third with 4¼% Ni, 1¼% Cr, 0.9% W, a nitrided steel of 0.30% C, 1% Cr, 1% Al, 0.20% Mo, nitrided to a depth of ¾ mm., a stainless steel of 18% Cr, 9% Ni, 0.12% C, and commercial Ni were tested. Tests were made at 600 to 1000 cycles/min. in air and in a stream of tap water, using a specimen of cylindrical test section, subjected to repeated (not rotary) bending on a Föppl-Heydekampf type machine. Unworked specimens, and those compressed between rollers under pressure to cold work the surface, were used. The tests were run at a given stress for 2 million cycles, and if unbroken, the stress raised 10% for another 2 million and so on. Because of strengthening by understressing, no true endurance limits, but only comparative data, were obtained. By a process of estimation, an alleged approximation to an endurance limit was calculated. The usual strengthening effect of cold-working the surface was noted, except on nitrided steel which was slightly damaged through cracking of the nitrided layer. Comparing the unworked steels in air and in water, the carbon steels showed a reduction in endurance through corrosion of about ½, the heat-treated alloy steels 2/3, the nitrided steel and the commercial Ni only about 5%, while the 18-8 type steel (apparently as rolled, not water- or air-quenched) showed a reduction of some 20% and the fractures were considered to be typical corrosion fatigue fractures. The previous data of Mailänder as to the corrosion fatigue resistance of nitrided steel were thus verified, but the former observations on the complete resistance of 18-8 were not. In the nitrided material, some of the fatigue fractures had their nuclei below the surface at the junction of zone and core. The individual life history of the 184 specimens tested is given in detail. The analyses of the materials are evidently type compositions only, no heat-treatment details are given, though the static properties are stated, but in some cases showed poor agreement. The Ni Cr steel varied in tensile strength from 125,000 to 180,000 lbs./in.^{2}. The so-called endurance limits (in air) as calculated by the authors from their short-cut method for the as-rolled carbon steels, were 42,000 and 39,000 lbs./in.^{2} respectively for steels whose specification tensile strengths were 71,000 and 52,500 lbs./in.^{2} (actual tests not made), i.e., the endurance ratios calculate to around 60 and 75, the latter of which, at least, is unlikely to be correct. Such variations and discrepancies are passed by the authors without comment. The results are thus chiefly of qualitative interest. HWG (9c)

Fatigue Testing. J. W. Cuthbertson. *Engineering,* Vol. 136, July 21, 1933, pages 55-57; July 28, 1933, pages 80-82. Alternating bending tests of the Wöhler rotating-bar type were made. The strain method used is a development of the original load-strain test invented and first used by Dr. J. H. Smith of Belfast. Diagrams are given showing the type of machine used. Typical load-deflection curves are shown and tables are given showing the fatigue limits of the materials tested at ordinary and elevated temperatures. Tests were made on mild steel, normalized and annealed, Duralumin and Y-alloy, forged and heat treated, 70:30 brass and Al. A mathematical treatment is given of the deflection of a rotating bar under a given load. LFM (9c)

Influence of repeated torsion on strength and damping power of metals, especially aluminum alloys (Der Einfluss von Drehschwingungsbeanspruchungen auf die Festigkeit und Dämpfungsfähigkeit von Metallen besonders von Aluminium Legierungen) H. Frankenberg. *Mitteilungen des Wöhler-Instituts,* No. 16, 1933, 55 pages, 62 figures, 6 references. A C steel, a Cr Mo steel, Al of 99.5 and 98%, and Al alloys with 2, 4 and 6% Cu, 5 and 13% Si, and with 2% Mg were studied. Endurance limits are listed for these, but are not to be depended upon since they are given only for 2 million cycles. The Al alloys had their yield strengths raised by repeated stressing close to the 2 million cycle endurance limits. The same result was obtained on the carbon steel by a few reversals through a large angle. The raising of the yield strength was obtained whether the repeated stressing was continuous or interrupted. Damping power, usually determined at 200 to 2000 reversals per minute was studied in the range 20 to 200 per minute. Results were similar to those at the higher range. HWG (9c)

A Study of the Influence of the Intercrystalline Boundary on Fatigue Characteristics. H. J. Gough, H. L. Cox & D. G. Sopwith. *Journal Institute of Metals,* Vol. 53, Nov. 1933, pages clvii to clxxxiii (Paper No. 651). Three specimens each consisting of 2 crystals of Al were obtained. All were subjected to alternating torsional stresses. Before stressing, the orientation of each crystal was determined by X-ray methods. Specimens were subjected to a number of alternations of stress and the slip bands on the surface examined. The resolved stress on each possible slip plane was calculated. In one specimen the grain boundary was almost perpendicular to the axis, in another it was almost parallel, and the third specimen consisted of a twin with an irregular boundary between the components of the twin. The distribution of the slip bands showed that the effect of the boundaries on the distribution of the stress was slight. The presence of the boundaries apparently did not affect the formation and propagation of cracks. There was no striking difference in the behavior of the 3 specimens examined. It is concluded that the presence of intercrystalline boundaries may considerably strengthen the constituent crystals against fatigue, but that the effect of the boundaries on the distribution or even the amount of slip is small. Also, it is probable that the major effect of the boundary lies in some restriction of strain that it imposes. JLG (9c)

Endurance Tests with a High-Frequency Tension-Compression Machine: Changes of Frequency and Elasticity Modulus respectively and their Importance for the Determination of Tension at Different Amplitudes (Dauerversuche auf einer hochfrequenten Zug-Druck-Maschine: Die Aenderungen der Frequenz bezw. des Elastizitätsmoduls und deren Bedeutung für die Spannungsermittlung bei verschiedener Schwingungsweite) Fr. Koerber & M. Hempel. *Mitteilungen aus dem Kaiser-Wilhelm-Institut für Eisenforschung,* Vol. 15, No. 10, 1933, pages 119-135. The determination of the elasticity modulus of a material by means of an "acoustic mushroom" (Tonpilz) (so-called because the assembly of specimen, clamping devices, measuring instruments and electromagnetic devices for generating the frequency of vibration under load of the specimen is similar to the shape of a mushroom) is exhaustively described. The influence of the amplitude and frequency of the oscillations of the stresses in the samples causes about 2-8% difference from measurements of the static elasticity modulus. The literature pertaining to this subject is reviewed; the original paper must be referred to for the results and their evaluation as they do not lend themselves to abstracting. 29 references. Ha (9c)

Effect of Shape, Processing and Material on the Fatigue Strength of Bolts (Dauerfestigkeit von Schrauben, ihre Beeinflussung durch Form, Herstellung und Werkstoff) Wilhelm Staedel. *Mitteilungen der Materialprüfungsanstalt an der Technischen Hochschule Darmstadt,* No. 4, 1933, 102 pages.
See "On Endurance Strength of Screws and Influence of their Shape, Manufacturing and Material," *Metals & Alloys,* Vol. 4, Sept. 1933, page MA 286. GN (9c)

Types of Fatigue Fractures (Über gesetzmässige Dauerbruchformen) H. Oschatz. *Schriften der Hessischen Hochschulen,* 1933, No. 2, pages 38-44.
Paper before Werkstofftechnisches Kolloquium der Staatlichen Materialprüfungsanstalt an der Technischen Hochschule Darmstadt, June 24, 1933. Author shows that the origin of fatigue cracks follows certain laws and develops these laws for (1) the areal relations between actual fatigue fracture and "rest fracture" of parts failed by fatigue, (2) the directional course of the path that the fatigue crack takes. Another important effect on the subdivision of the fractured area is the type of first crack formation. These must be distinguished between fatigue cracks starting from local points and those showing a line shape. However, not only the area of first crack formation affects the appearance of the crack but also the distribution of stresses over the whole area. As far as the path of the fatigue crack is concerned the author found that it always follows a curve normal to the stress lines. GN (9c)

A Machine for Testing Fatigue Phenomena (Eine Maschine zur Prüfung von Ermüdungserscheinungen) J. N. Morosow. *Korrosion, Supplement to Chemische Apparatur,* Vol. 8, Apr. 25, 1933, page 15. The machine was developed in the Metal Institute in Leningrad. The beam to be tested is loaded on one end by alternating torsion while the other end is clamped rigidly; at the same time also bending moments can be produced. The machine works entirely automatically. Hap (9c)

Vibration Strength of Welded Steel Pipe Joints (Schwingungsfestigkeit von Stahlrohrschweissverbindungen) J. Mueller. *Zeitschrift Verein deutscher Ingenieure,* Vol. 77, July 1, 1933, pages 720-721. Unalloyed steels with different C contents and alloyed steels with Cr-Mo and Mn were subjected to alternating bending stresses; this is more often met with in practice than torsional stresses. The strength of welded pipes increases at first with C content; but from 0.4% C upward a decrease in oscillating strength can be observed; the maximum of 50 kg./mm.^{2} for static and 20 kg./mm.^{2} for dynamic strength occurs at about 0.35% C so that a further increase of C is of no practical value. Mn steel pipe showed about 14-19 kg./mm.^{2} dynamic strength, Cr-Mo steel pipe about 17-22 kg./mm.^{2} C, Mn and Si content seem to reduce the dynamic strength due to the overheated welded zone. In all cases a welding wire 0.1% C, 0.1% Si, 0.4-0.6% Mn, 0.025% P and 0.03% S was used. In general the results obtained showed higher strength values than with the torsional stress. Hap (9c)

Endurance Fracture of Welded Joints (Beitrag zur Klärung des Dauerbruches geschweisster Verbindungen) W. Hoffmann. *Autogene Metallbearbeitung,* Vol. 26, Apr. 1, 1933, pages 100-102; *Forschungsarbeiten auf dem Gebiete des Schweissens und Schneidens mittels Sauerstoff und Azetylen,* Series 8, 1933, pages 68-71. Recent endurance tests with butt welded joints have confirmed again that their strength is superior to a riveted joint statically and equal dynamically. Lap welds must take into consideration the stress distribution. It is shown how with correct assumption of stress conditions the endurance strength can be evaluated with great certainty. Joints made with high-grade welds which stand deformation are most reliable. Additional material which does not well stand alternating stresses should be avoided. In general it can be stated that welded butt-joints have 100% of the strength of riveted joints. Hap (9c)

Magnetic Testing (9d)

L. REID, SECTION EDITOR

Magnetic Test Locates Flaws in Valve Springs. Alfred V. DeForest. *Iron Age,* Vol. 130; July 21, 1932, page 107, adv. sec. page 18. Recent investigation of spring steels and wire springs showed harm done by decarbonized layers inheriting defects from ingot and also defects due to rolling. Breakage occurs during motor tests and appears to be a fatigue failure. The magnaflux method of testing was employed which consists of magnetizing steel in such a way as to cause minute magnetic pole at edge of any seam, crack or discontinuity, at or immediately below surface. On dusting with finely divided Fe particles or with steel in light oil carrying finely divided Fe in suspension, magnetic particles are located by polar effect and thus indicate presence of a defect. VSP (9d)

Physical Methods of Analytical Chemistry. Part I. Spectrographic and Radiographic Analysis (Physikalische Methoden der Analytischen Chemie. Erster Teil. Spektroscopische und Radiometrische Analyse) G. Scheibe, H. Mark & R. Ehrenberg. Akademische Verlagsgesellschaft, Leipzig, 1933. Cloth, 6¼ x 9¼ inches, 388 pages. Price 36 RM. This book would be of value to the metallurgist who wishes an introduction to the subjects treated under the following three divisions:

I. Chemical Spectrum Analysis. G. Scheibe

A very complete survey of qualitative and quantitative spectrum analysis. A number of useful tables are included. One hundred eighty-four pages.

II. Chemical Analysis with X-rays. H. Mark

A thorough review of qualitative and quantitative methods, especially complete from the apparatus standpoint. A good set of wavelength tables are given. One hundred forty-seven pages.

III. Radiometric Methods. R. Ehrenberg

A short (thirty-six pages) review of the technique and applications of radioactive indicators.

To each section is appended an extensive bibliography.

F. M. Walters, Jr. + H. A. Smith (9e) -**B**-

Magnetic Dust is Magic Dust. *Industry & Welding,* Vol. 6, Aug. 1933, pages 4-6. A method for inspecting and testing of welds is described in which the piece to be tested is magnetized and dusted with a prepared magnetic powder. When the piece is tapped all the powder falls off unless there is a flaw which is clearly outlined by a ridge of powder. Interior cracks, etc., can safely be detected. A few photographs show the results. Ha (9d)

Do Strictly Reversible Phenomena Exist in the Magnetization of Ferromagnetic Substances by Extremely Small Alternating Fields? (Gibt es in Strenge reversible Vorgänge bei der Magnetisierung ferromagnetischer Körper durch extrem kleine Wechselfelder?) Heinz Wittke. *Annalen der Physik,* Series 5, Vol. 8, Nov. 1933, pages 679-700. To determine the quality of iron cores used in telephonic transmission and in Pupin coils their efficiency or the loss in them resp. must be measured exactly for the very small magnetic fields occurring hereby. The tests and comparison with former methods are described in detail, the results are summarized briefly: For very small changes of the magnetic field the ratio of loss to the change of magnetic energy is proportional to the change of field, this is therefore a reversible phenomenon. If, however, the small cycle starts from the non-magnetic state the change of state is not reversible, this means that the transformation of a small alternating current is always connected with losses. The loss depends on the material and amounts to about 0.1% of the change of magnetic energy. 16 references. Ha (9d)

Magnetic Induction of Iron in Tensile Test (Untersuchung der Induktion von Eisen beim Zugversuch) F. Schmidt. *Elektrotechnische Zeitschrift,* Vol. 54, Feb. 16, 1933, pages 160-161. The change of magnetization of magnetically soft and hard material when subjected to tensile stresses in a constant magnetic field is substantially the same. The critical stress points are indicated by the magnetic curve, the elastic limit is clearly designated by an inflection point. The magnetic inflection points are increased by cold-working of the material, the magnetization curve is shallower in cold-worked material. In general, the magnetic behavior is a good indicator of mechanical properties. Ha (9d)

Determination of Magnetic Properties of Small Sheet Specimens (Ermittlung der magnetischen Eigenschaften an kleinen Blechproben) J. Pfaffenberger. *Archiv für das Eisenhüttenwesen,* Vol. 7, Aug. 1933, pages 117-120. The AEG magnetic testing apparatus for small sheet is described. Laminated samples weighing as little as 50 g. can be tested without special preparation. The discussion indicated the results were not always comparable with those in the standard Epstein test. SE (9d)

Determining the Temperature of Magnetic Changes in Alloys. *Wire & Wire Products,* Vol. 8, Nov. 1933, page 372. Describes an arrangement in which the sample to be tested for its magnetic condition is placed between 2 Co bars and magnetic energy transmitted from one to the other. If the sample is heated to such temperature that it becomes non-magnetic no energy can be transmitted. Ha (9d)

METALLOGRAPHY (10)

J. S. MARSH, SECTION EDITOR

X-ray Examination of Calcium at Elevated Temperatures (Röntgenographische Untersuchungen an Kalzium bei höheren Temperaturen) L. Graf. *Metallwirtschaft.* Vol. 12, Nov. 10, 1933, pages 649-653. Ca of 95.4% purity was extruded hot into wire and was examined under vacuum at temperatures up to 500° C. in a small, specially built X-ray diffraction apparatus. An allotropic transformation from the face-centered cubic lattice with a constant a=5.56 to a body-centered cubic lattice with a constant a=4.43 takes place at 450° C. This explains the irregularities at this temperature in cooling, dilatometer, and electric-resistance curves which have been previously observed. The density of the α phase at 450° is 1.48 and of the β phase at 480° is 1.52. (This is probably a typographical error of transposition in the original. The transformation is to a less closely packed lattice, hence less dense.—John S. Marsh). The irregularities in the electrical-resistance-temperature curve of Ca wire which was extruded at 300° as compared with soft temper wire, which were found by Schulze, are caused by intense lattice disturbances due to the 100% reduction in extruding. These disturbances are not relieved at temperatures below 300° but are relieved at 345°, when a very rapid recrystallization takes place, which causes the peculiar kink in the resistance-temperature curve. CEM (10)

Cu-Pb Alloy System. M. Nishikawa. *Suiyokwai-shi,* Vol. 8, June 1933, pages 239-243. Constitution of Cu-Pb system was investigated by thermal and microscopic studies and the equilibrium diagram was obtained. A monotectic reaction Liquid + Cu $\rightleftarrows$ Liquid was found to occur at 956° C. the liquids containing 13 and 48% Cu, respectively. HN (10)

An X-ray Study of the Diffusion of Chromium into Iron. Laurence C. Hicks. *American Institute Mining & Metallurgical Engineers. Contribution* No. 58, Oct. 1933, 10 pages. A small block of electrolytic Fe was packed in Cr powder and heated in a vacuum at 1200° C. for 96 hr. The polished and etched specimen showed that a border of columnar crystals had formed. The border was straight and parallel to the surfaces. The specimen was ground to different depths and the lattice parameters at different depths determined by a precision method of X-ray diffraction. Using the lattice constant-concentration curve obtained by Preston the composition of the specimen at different depths was estimated. The Cr concentration dropped steadily from 68 at. % at the surface to 15 at. % at the end of the columnar grains; it then dropped to almost zero. These observations indicate that at 1200° C. the γ loop in the Fe-Cr system extends to 14 or 15 at. % rather than to 10 at. % as found by Adcock. The results also indicate that the mechanism of diffusion described by Bannister and Jones is correct. 8 references. JLG (10)

Iron-Cobalt-Manganese System (Das System Eisen-Kobalt-Mangan) W. Köster & W. Schmidt. *Archiv für das Eisenhüttenwesen,* Vol. 7, Aug. 1933, pages 121-126. The Co-Mn system was studied by determining the γ-ϵ and magnetic transformations. SE (10)

Behavior of "Graphitic Silicon" in Aluminum at Elevated Temperatures (Über das Verhalten des "graphitischen Siliziums" im Aluminium bei höheren Temperaturen) C. Schaarwächter. *Zeitschrift für Metallkunde,* Vol. 25, Oct. 1933, pages 250-251. It is shown by microscopic observations that the Si precipitated from the solid solution of Si in Al (graphitic Si) redissolves in Al on reheating with extreme slowness and that only at temperatures in the neighborhood of the eutectic temperature, 577°, is the solution process rapid enough to be observed. Followed by short discussion. RFM (10)

The Microscope in Engineering. *Journal of Commerce (Shipbuilding & Engineering Edition),* July 20, 1933, page 1. The value of the microscope in estimating the behavior of materials under service conditions is discussed with special reference to the examination of castings, welds, and the investigation of failures caused by inclusions and segregation. JWD (10)

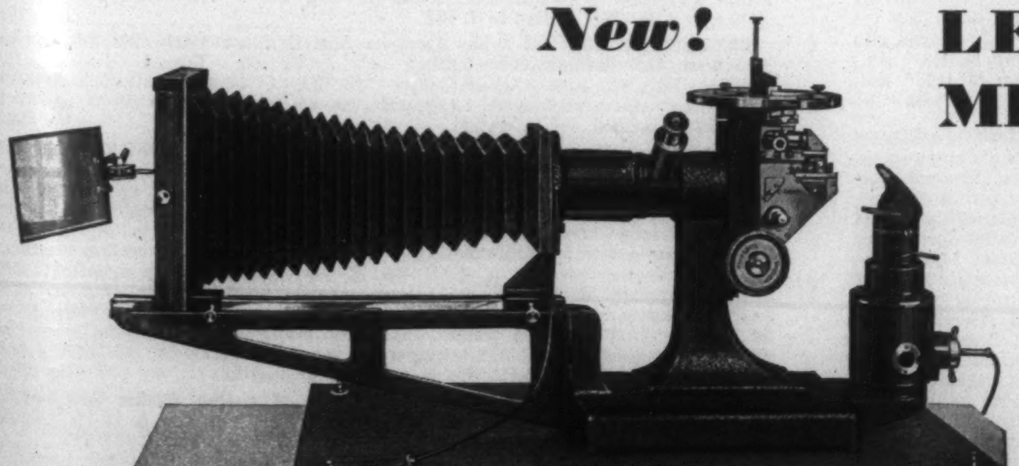
Some Investigations of Cast Alloys. V. Perkins Metal. Gunji Shinoda. *Japanese Journal of Engineering,* Abstracts, Vol. 9, 1933, page 69. The effect of annealing upon the electric resistance of cast bronzes with 18-24% Sn was found to be less remarkable in chill-cast alloys than in quenched ones as previously established. Experimenter found that Cu_3Sn has no definite melting point. A correlation of electric potential to microstructure was found in tempered alloys of 24% Sn. The "reaction rims surrounding martensitic needles" must be a kind of Sn-rich solid solution whose specific resistance must be less than that of Cu_4Sn. From this standpoint the remarkable minimum of resistance at about 340° C. is explained. Laue photographs showed that the effect of tempering appears first at about 200° C. At 300° C. the structure becomes fibrous. WH (10)

Solidification Diagrams of Alloys of Two Alkaline Metals. Sodium-Potassium Alloys (Diagrammes de solidification des alliages formés par deux métaux alcalins. Alliages sodium-potassium) E. Rinck. *Comptes Rendus,* Vol. 197, July 3, 1933, pages 49-51. Having described the apparatus used in his experiments, the author deals with their results which serve to confirm the existence of an unstable compound Na_2K and of a eutectic freezing at — 12.5° C. and containing 66 atomic % of K. OWE (10)

Influence of Heavy Metals Upon Aluminum Alloys (Einfluss von Schwermetallen auf Aluminiumlegierungen) P. Röntgen & W. Koch. *Zeitschrift für Metallkunde,* Vol. 25, Aug. 1933, pages 182-185. A microscopic study of the solid solubility of Ni, Cr, and Mo in Al at 560°, and of the effect of these elements on the solid solubility of Cu in Al. The solid solubilities are: Ni:0.01-0.02%; Cr:0.02% Mo:0.02%; the solid solubility of Cu in Al is not increased by additions of Ni, Cr, and Mo. RFM (10)

The System Copper-Beryllium (Über das System Beryllium-Kupfer) H. Tanimura & G. Wassermann. *Zeitschrift für Metallkunde,* Vol. 25, Aug. 1933, pages 179-181. The solid solubility of Be in Cu was determined by precision X-ray measurements of a_o, the side of the unit face-centered cubic cell. This solubility amounts to 2.1 weight % Be at the maximum (800°), decreasing to less than 1% Be at temperatures below 200°. The γ phase was recognizable on the photograms at temperatures as low as 150°; a_o varies approximately linearly from 3.608 A.U. in pure Cu to 3.566 A.U. in an alloy with 2.1 weight % Be. RFM (10)

Investigation into the Crystal Structure of Nitrides and Phosphides of Bivalent Metals (Untersuchungen über die Kristallstruktur der Nitride und Phosphide zweiwertiger Metalle) M. von Stackelsberg & R. Paulus. *Zeitschrift für physikalische Chemie,* Abt. B. Vol. 22. Aug. 1933, pages 305-322. Reports on preparation and properties of Mg_3P_2 and Mg_3N_2 single crystals, and of preparations of powder photographs referring to phosphides of Be and Mg and nitrides of Be, Mg, and Ca. The investigations included arsenides, nitrides and phosphides of bivalent metals. Mg_3P_2 single crystals revealed the same atomic arrangment as the cubic oxides Me_2O_3 according to Pauling. The space group is T_h^7. The P atoms represent a slightly deformed lattice of a close-packed arrangement. About ¼ of the metal-atom places are unoccupied (Na_2O or CaF_2 lattice). Powder photographs from Be_3P_2, Be_3N_2 Mg_3N_2 (also single crystals and α-Ca_3N_2) disclosed that these substances also possess the Mg_3P_2 structure. The nitrides and phosphides of Ca, Sr, and Ba do not crystallize in the cubic system. Single crystals of Zn_3P_2, Cd_3P_2 and Zn_3As_2 were secured exhibiting a cubic arrangement but not of the Mg_3P_2 type. These Zn and Cd compounds display metallic character. EF (10)



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X-ray Proof of Compound ZrW_2 (Röntgenographischer Nachweis der Verbindung ZrW_2) A. Claasen & W. G. Burgers. *Zeitschrift für Kristallographie,* Vol. 86, Aug. 1933, pages 100-105. Zr deposited from the gaseous state on incandescent W wire yielded an X-ray diagram of a compound unknown heretofore. Evaluation of the diagram yielded ZrW_2 exhibiting a face-centered cubic structure with 8 molecules of ZrW_2 in the elementary cell, the edge length amounting to 7.61 A.U. The computed density is 13.78 and a melting point of approximately 2200°C. has been found experimentally. An intermetallic compound of the same structural type has been discovered before, Cu_2Mg, by J. B. Friauf. (*Journal of American Chemical Society,* Vol. 49, 1927, page 3107.) EF (10)

Roentgenographic Investigations in the System (Zn, Cd)-Sb. II. [Röntgenographische Untersuchungen im System (Zn, Cd)-Sb. II.] F. Halla, H. Nowotny & H. Tompa. *Zeitschrift für anorganische und allgemeine Chemie,* Vol. 214, Sept. 19, 1933, pages 196-200. The lattice constants of Cd_3Sb_2 were determined to $a = 7.20$, $b = 13.51$, $c = 6.16$ A.U.; $\beta = 100° 14'$, $V = 590$ (A.U.)^3; that of ZnSb: $a = 6.17$, $b = 8.27$, $c = 3.94$ A.U. Crystals of Zn_3Sb_2 proved to be pseudomorphs which disintegrated into Zn and ZnSb. Ha (10)

An Investigation of the Heat-Treatment of "Standard Silver." Hugh O'Neill, G. S. Farnham & J. F. B. Jackson. *Institute of Metals Advance Copy* No. 646, Sept. 1933, 11 pages. Meyer hardness analyses were made of heat-treated "Standard silver" (7.25% Cu, balance Ag). Precision X-ray diffraction patterns of the alloy were obtained. Results are compared with those reported by Ageew, Hansen and Sachs. Agreement is not good. JLG (10)

Composition of the Carbides in Chromium Steels (Die Zusammensetzung der Karbide in Chromstählen) E. Maurer, T. Döring & H. Buttig. *Archiv für das Eisenhüttenwesen,* Vol. 7, Oct. 1933, pages 247-256. The carbides in steels containing 0.4-1.2% C and 0.5-30% Cr were spheroidized as much as possible and isolated by dissolving the steels in weak acids or electrolytically, and the chromium-iron carbides obtained analyzed. The chromium-carbide portions of the residues were found to be composed of Cr_3C_2 and Cr_4C_2. the former appearing in steels with 5-7% Cr and the latter in higher Cr steels. Chromium-carbides of the composition Cr_7C_3, Cr_5C_2. or Cr_4C were not found. As a result of the analyses made, it was possible to determine the relative distribution of the Cr between carbide and ferrite; these results are shown in graphs. According to these, in a 1% C 20% Cr steel, about 40% of the Cr is present as carbide and 60% is dissolved in the ferrite. In discussion W. Tofaute contributed a diagram of the phase fields in the Fe-Cr-C system at 750° C. 12 figures, 21 references. SE (10)

Studies upon the Widmanstätten Structure, V.—The Gamma-Alpha Transformation in Pure Iron. Robert F. Mehl & Dana W. Smith. *Metals Technology,* Jan. 1934, Technical Publication No. 521, 7 pages. A thin strip of electrolytic Fe of high purity was drastically quenched from 950° C. It developed a Widmanstätten figure. Measurements of traces on polished and etched surface permitted the determination of the orientation of the parent gamma-Fe lattice. X-ray diffraction patterns with white radiation gave data for the construction of pole figures showing the orientation of the alpha-Fe crystallites. The figure in the quenched sample is on the $\{111\}$ planes of gamma Fe. The orientations of the alpha Fe with respect to that of the parent gamma iron were: $\{111\}\ \gamma$ parallel to $\{110\}\ \alpha$ and $[110]\ \gamma$ parallel to $[111]\ \alpha$. The relationship is therefore the same as that of martensite to gamma iron. JLG (10)

Measurements by Means of Liquid Helium. XXII. Resistance of Metals, Alloys and Compounds (Messungen mit Hilfe von flüssigem Helium. XXII. Widerstand von Metallen, Legierungen und Verbindungen) W. Meissner, H. Franz & H. Westerhoff. *Annalen der Physik,* Series 5, Vol. 17, July 1933, page 593. Supra-conductivity was determined for a number of instances. Pure Nb is supra-conducting at 9.2° abs. and shows the highest discontinuity point of all materials so far investigated. Pb-As form heterogeneous mixtures and become supra-conducting at the discontinuity point for Pb. Mo-C alloys with 42-58 atomic % C have the discontinuity at 8.5° abs. Several substances of uniform crystal structure and also arsenides and W bronzes did not show any supra-conductivity down to 1.3° abs.; also selenides and tellurides did not become supra-conductors down to 1.26° abs. All tests are given in detail. 16 references. Ha (10)

Electron Interference on Ground and Polished Surfaces (Elektroneninterferenzen an geschmirgelten und polierten Flächen) H. Raether. *Die Naturwissenschaften,* Vol. 21, July 21, 1933, page 547. By means of electron interference (glancing incidence) a study was made of the surface changes on polycrystalline metals such as Cu, Ag, Ni, steel on one hand and on cleavage planes of non-metallic bodies as NaCl, $CaCO_3$, CaF_2, etc., on the other hand due to mechanical work, i.e. due to grinding and polishing. A marked difference between the two was established. The cleavage planes of non-metallic materials, which furnished single crystal reflections, yielded powder diagrams after being ground and after polishing distinct fibre structure and partly even single crystal reflections. The ground surface of the metals also exhibited powder interferences, however, in the highly polished state, powder diagrams were obtained characterized by 2 wide interference rings, the calculated layer plane distances of which cannot be connected with the original space lattice dimensions. The differences were negligible for the different metals studied. This phenomenon indicates a structure of the outermost surface layer which may be interpreted as transitional between the crystalline and liquid state. An analogous case was found in hammered and pressed metals. In grinding the brittle non-metallic materials, minute crystals were torn out, the resulting effect being powder diagrams whose rings approached fiber structure with increasing smoothness of the surface. EF (10)

The Constitution of the Aluminium-rich Aluminium-copper Alloys above 400° C. D. Stockdale. *Institute of Metals,* Advance Copy No. 648, Sept. 1933, 6 pages; *Metal Industry,* London, Vol. 43, Sept. 22, 1933, page 287. The solidus and limit of solubility of Cu in Al above 400° C, were determined by microscopic methods. The Al used contained not more than 0.03% impurities other than Cu. JLG + Ha (10)

Notes on the Cadmium-nickel System. Carl E. Swartz & Albert J. Phillips. *American Institute Mining & Metallurgical Engineers, Contribution* No. 55, Oct. 1933, 4 pages. Cd-rich alloys were investigated by cooling curves and microscopic examination. A eutectic melts at 318° C. and contains 0.25% Ni. The components of the eutectic are almost pure Cd and a phase of the approximate formula $NiCd_7$. The compound (?) is formed by a peritectic reaction at 490° C. Microstructures of several alloys are shown. Excess $NiCd_7$ crystallizes as plates or as cubes. An alloy containing 1.30% Ni had excellent properties as a bearing metal. JLG (10)

The Effect of Lattice Distortion and Fine Grain on the X-Ray Spectra of Metals. W. A. Wood. *London, Edinburgh & Dublin Philosophical Magazine & Journal of Science,* Ser. 7, Vol. 15, Mar. 1933, pages 553-562. 8 references. Attempts to differentiate between the effects of fine grain and of lattice distortion on the X-ray spectrum of a metal. Suggests a method for calculating the proportionate contribution of each factor to the broadening of the X-ray diffraction lines. Results are applied to the particular case of electrodeposited Ni; it is shown that both factors must be taken into account in considering the observed diffusion of the X-ray spectra of Ni in this form. Diffusion of an X-ray spectrum of electrodeposited Ni may in some cases be due to the occurrence of an ultra-fine grain. Fine-grained structure of Ni deposits can be accompanied by lattice distortion. RHP (10)

Magnetism and Disturbances of Crystal Lattices. Roentgenographic Investigations on α-Iron (Magnetismus und Kristallgitterstörungen. Röntgenographische Untersuchungen an α-Eisen) F. Regler. *Zeitschrift für Physik,* Vol. 82, May 1933, pages 337-354. The crystal lattice of ferromagnetic substances is changed by magnetic fields; the changes depend on magnitude and kind of magnetic field and condition of stress of the material under investigation. Numerical values of lattice deformation and torsion of lattices were determined by measuring interference phenomena under X-ray radiation. Ha (10)

X-Ray Analysis of Alloys of Mercury with Silver, Gold, and Tin (Röntgenanalyse der Legierungen von Quecksilber mit Silber, Gold und Zinn) Sten Stenbeck. *Zeitschrift für anorganische und allgemeine Chemie,* Vol. 214, Sept. 2, 1933, pages 16-26. Previous results on the Ag-Hg system of Murphy and Preston were confirmed. The alloy with 7% Hg is of the same type as γ-brass. Lattice parameters were measured. The system Au-Hg shows at least 5 different intermediary solid phases at room temperature. They occur at 67.72 and 80% Hg as δ, ϵ and γ phases respectively and have very complicated structures. Their dimensions were measured. The Sn-Hg system shows with increasing Hg content a type of crystal with simple hexagonal structure at about 8% Hg. Higher Hg contents seem to distort the structure to a rhombic form. Lattice parameters were determined. Ha (10)

Effects of Variations in Mould and Pouring Temperatures on Macro- and Microstructures of Some Low Melting Point Metals and Alloys. Frances D. Weaver (Mrs. Harold Heywood). *Metal Industry,* London, Vol. 42, Apr. 7, 1933, pages 373-377; Apr. 14, 1933, pages 395-396, 402. See *Metals & Alloys,* Vol. 4, Nov. 1933, page MA 346. Ha (10)

Some Practical Applications of X-Ray Analysis. V. E. Pullin. *Metal Industry,* London, Vol. 43, Oct. 20, 1933, pages 393-394. The use of X-rays for the analysis of crystals, for detecting the effects of coldwork and annealing, and for chemical analysis and the principles of the method as developed by Bragg and Laue are explained. Ha (10)

Investigation of the System Au-Cu by Measuring the Resistance at Low Temperatures (Untersuchung des Systems Au-Cu durch Messung des Widerstandes in tiefen Temperaturen) V. Pospisil. *Annalen der Physik,* Series 5, Vol. 18, Nov. 1933, pages 497-514. Electric resistance of a series of 59 Au-Cu alloys from 10-100% Au was measured between –195 and –252.4° C. The results are represented in a table containing the ratio of the resistances at 0° and –195 and –252.4°, and also the specific resistance of the alloys. Measurements were made on quenched and on annealed material. 18 references. Ha (10)

Electron Interferences on Mechanically Worked Surfaces (Elektroneninterferenzen an mechanisch bearbeiteten Oberflächen) H. Raether. *Zeitschrift für Physik,* Vol. 86, Oct. 17, 1933, pages 82-104. The changes which polycrystalline metallic surfaces undergo by scratching, grinding, polishing, hammering, and extruding were determined by interference rings of electrons impinging on the surface. Tests are described and photographs shown. Ha (10)

Detection of Lattice Distortion by X-Rays (Nachweis von Gitterstörungen mit Röntgenstrahlen) B. Pfarr. *Zeitschrift für technische Physik,* Vol. 14, No. 6, 1933, pages 220-221. Spectral lines are widened by cold-working of a metal and offer in this way a means to determine lattice distortion by measuring the width of the lines in the X-ray spectrum. No such simple relation was found for hot working. Ha (10)

The Application of X-Rays in the Field of Electrodeposition. N. Promisel. *Metal Industry,* London, Vol. 43, Nov. 3, 1933, pages 437-441. The recent progress in X-ray work in determining structural conditions is reviewed; information so far yielded by X-ray study refers to determination of crystal orientation in the deposit, thickness, temperature influence, most favorable concentrations and current densities, direction of crystal growth, measurement of grain size, detection of alloying between deposit and base metal or between 2 or more co-deposited metals. Suggestions are made for further fields of X-ray study in plating problems. Ha (10)

Lattice Structure of Indium (Gitterstruktur des Indiums) E. Zintl & S. Neumayr. *Zeitschrift für Elektrochemie,* Vol. 39, Feb. 1933, pages 81-84. The investigation of an In monocrystal revealed a face-centered tetragonal structure with $a = 4.583 \pm 0.002$ A.U., $c = 4.936 \pm 0.002$ A.U. and $c/a = 1.077 \pm 0.001$ A.U. The density is 7.308. Ha (10)

Development of Chemical X-Ray Spectrum Analysis Since 1927 (Die Entwicklung der chemischen Roentgenspektralanalyse seit 1927) Fr. Voges. *Angewandte Chemie,* Vol. 46, June 3, 1933, pages 323-325. Useful methods with both emission and absorption spectra for quantitative analysis have been developed. They are briefly described. 14 references. Ha (10)

Constitutional Diagram of Cu-Sn-P Alloys (Ueber das Zustandsschaubild der Cu-Sn-P-Legierungen) J. Veroe. *Zeitschrift für anorganische und allgemeine Chemie,* Vol. 213, July 21, 1933, pages 257-272. The behavior of Sn bronzes was studied thermally and microscopically in the Cu-corner of the system Cu-Sn-P. Eutectic crystallization took place only in alloys poor in Sn; in alloys rich in Sn the peritectic transformation $\alpha + S \longrightarrow \beta$ occurs as secondary reaction, and also a 4-phase reaction $\alpha + S \longrightarrow \beta + Cu_3P$. A ternary eutectic is not formed. Structure of the examined alloys showed, besides bronze crystals, only Cu_3P. Saturation limits of the different kinds of bronze crystals are displaced, in the presence of P, in such manner that their projection on the base moves in straight lines which connect the corresponding point of the Cu-Sn side of the triangle with the point of Cu_3P. This is explained at length. Ha (10)

Brittleness, Plasticity, and the Slip Elements of α-Iron (Ueber Sprödigkeit, Plastizität und die Gleitelemente das α-Eisens) F. Sauerwald & H. G. Sossinka. *Zeitschrift für Physik,* Vol. 82, May 23, 1933, pages 634-643. Slip phenomena and brittleness were investigated in monocrystals at low temperatures. Slip takes place on the [112] planes. The range of brittle fracture extends from –98° to –136° C. Ha (10)

Analysis of Secondary X-ray Radiation of Al, Ni, Ag, and Au on the Incident and Emergent Sides (Die Analyse der Sekunder strahlung von Al, Ni, Ag und Au auf der Ein-und Austrittsseite der Röntgenstrahlen) Hans Schenck. *Annalen der Physik,* Series 5, Vol. 17, May 1933, pages 146-168. The electron emission of Al, Ni, Ag, and Au was determined as a function of hardness of the X-ray radiation and of thickness of the radiated element on the incident and emergent sides. Results of measurements are given in detail. Ha (10)

The Mechanism of Plastic Deformation (Ueber den Mechanismus der plastischen Deformation) A. W. Stepanow. *Zeitschrift für Physik,* Vol. 81, No. 7/8, 1933, pages 560-564. From results of recent investigations a hypothesis is supported which states that the energy of plastic deformation is localized during its conversion into heat in a narrow zone next to the sliding bands whereby a temporary destruction of the lattice structure in the range of these zones takes place. The process of deformation was followed by the changes of electric conductivity. Results are described in detail. Ha (10)

Visualization of the Primary Structure of Steels by Addition of Radioactive Thorium B (Sichtbarmachung des Primärgefüges der Stähle durch Zusatz von radioaktivem Thorium B) G. Tammann & G. Bandel. *Archiv für Eisenhüttenwesen,* Vol. 6, Jan. 1933, pages 293-296. Addition of radioactive Pb-isotope ThB to electrolytic Fe and different steels to the amount of 1×10^{-6}% maximum made it possible to photograph the primary structure and submicroscopic inclusions of slag when the ground and polished sections were placed on photographic plates. Contrary to the Oberhoffer etching method, the radiograms show dark edges of the crystallites where the radiating ThB accumulates. The center is light. As ThB has only a very short life the radiogram must be taken very soon after the sample has been melted. Radioactive U requires longer time of exposure on account of its longer half-life value, but cannot be used in molten Fe as it does not dissolve in it; it does in Ni, however. Several reproductions of radiograms show the very clear structural pictures which this method gives. Ha (10)

Structure of Cast Iron (Gusseisen-Gefügelehre) MAXIMILIAN FRH. V. SCHWARZ. *Forschungsarbeiten über Metallkunde und Röntgenmetallographie,* Folge 10, 1933, 164 pages. Although published as a journal article this is really a text. It contains almost no heretofore unpublished material, but the literature is reviewed with clarity. The first of 2 parts contains an elementary discussion of equilibrium diagrams, a description of the Fe-C diagram, sections on the influence of various elements on the properties of cast iron, sections on irons of high strength and their production, and a discussion of diagrams of the Maurer type. Part 2 describes the constituents and structures found in cast iron. It also points out how the structure influences the properties. The influence of alloying elements is described and growth is discussed. The work has adequate indexes. There are almost 100 references, and not all of them are to German literature. JLG (10)

Polymorphous Transformation of Calcium (Über eine polymorphe Umwandlung des Kalziums) A. SCHULZE & H. SCHULTE OVERBERG. *Metallwirtschaft,* Vol. 12, Nov. 3, 1933, pages 633-635. Logarithmic cooling curves of Ca, which was 95.4% pure, show a change in direction between 430 and 450° C. Above and below this range the curves are straight lines corresponding to the different specific heats of the two phases. The thermal expansion curve determined with a differential dilatometer shows a sudden contraction between 430 and 450° equal to .6% change in length. It is reversible with falling temperature. The electrical resistance measurements were made on 2 mm. dia. wire placed in Ni tubes to prevent oxidation. The resistance also shows a change between 430 and 450°, a decrease of 5.8%. It is not completely reversible. All these results indicate a polymorphous transformation of Ca between 430 and 450°. The heat of transformation, 2.3 calories, was determined in a small water calorimeter. A sharp kink at 350° in the electrical resistance curve is due to recrystallization of the Ca. 6 references. CEM (10)

Investigations on the Supposed Allotropy of Aluminum (Über die Untersuchungen der angeblichen Allotropie des Aluminiums) A. SCHULZE. *Metallwirtschaft,* Vol. 12, Nov. 17, 1933, pages 667-669. The results of 20 published investigations on Al using electric, thermal and X-ray methods are briefly reviewed. All of the more recent investigations agree in the conclusion that pure Al has no allotropic transformation point up to 600° C., and has a face-centered cubic lattice. The slight irregularities observed by some in the electric-resistance curves are caused by the presence of impurities in the Al. CEM (10)

Recrystallization of Metals. M. I. ZAKHAROVA. *Tzvetnuie Metallui,* No. 3, Mar. 1932, pages 346-351. A review of the modern conceptions of recrystallization of metals. 12 references. BND (10)

Diffusion of Copper in Iron in Connection with the Manufacture of Bi-metals. M. I. ZAKHAROVA. *Tzvetnuie Metallui,* No. 4, Apr. 1932, pages 542-550. (In Russian.) In connection with manufacture of Cu-Fe bi-metallic wire the authors investigated diffusion of Cu into Fe. No diffusion of Cu was observed when molten Cu was poured around pure-iron bars, but some iron diffused into the Cu and formed particles of Fe-rich solid solution. In further experiments 8 and 15% solutions of Fe in Cu were used. No diffusion of Cu was observed when pure iron was held in molten Fe-Cu alloy for 6 hours. When commercial iron was used, intergranular diffusion took place. The authors concluded that the diffusion of Cu (solution) in Fe and the formation of a zone of Fe-Cu solid solution between the Cu and the Fe are too slow to be economically utilized in commercial manufacture of Cu-clad Fe or steel wire. BND (10)

Darkfield Illumination Adds Contrast and Resolving Power. W. ZIELER. *Metal Progress,* Vol. 23, Jan. 1933, pages 19-23. Disadvantages of vertical illumination in metallurgical microscopes are discussed with illustrations. Design and characteristics of a darkfield illuminator are described. By use of an opaque stop in the illumination tube and 2 spherical mirror surfaces outside the objective, illuminating rays pass around the objective and onto the specimen at a very oblique angle. This eliminates lack of focus or spherical aberration. The new equipment has a new design of objective corrected for infinity, thicker reflecting glass plates in the body of the tube, and a thick glass block around the objective. The contrasting of brightfield and darkfield images brings out valuable features. A comparison of brightfield and darkfield illuminated micrographs of a high speed steel is illustrated. WLC (10)

Oil Immersion Objectives. WOLFGANG ZIELER. *Metal Progress,* Vol. 23, Feb. 1933, page 49. The statement that oil immersion objectives are of no value in metallurgical work in the author's article in the Jan. issue is erroneous. Reference was intended only to immersion objectives using liquids of higher refractive index than oil. WLC (10)

Iron-Carbon Alloys Containing Much Sulphur. KOTARA HONDA. *Metal Progress,* Vol. 23, Mar. 1933, page 45. The phase changes of the compounds FeS and MnS, coexistent in steel and cast Fe, have been studied by Tomo-o Sato. Thermal analysis of 75 alloys was made and the results are shown in an equilibrium diagram of the Fe-Fe_3C-FeS system. Alloys containing considerable C and S have a ternary eutectic, rich in FeS, in a globular form. Alloys in certain composition ranges do not melt into a homogeneous phase, but separate into 2 phases. The monotecto eutectic reaction takes place at 1103° C., the phase containing a smaller amount of S finally disappears. The remaining S-rich phase solidifies as a ternary eutectic, separating γ Fe, cementite and FeS. The existence of a transformation point at about 1400° C. in the alloys containing up to 23% FeS was discovered. FeS was found to have 2 polymorphic transformation points at 135° and 308° C. respectively, also observed in Fe-FeS and Fe-Fe_3C- FeS alloys. WLC (10)

A Note on the A_3 Point of Highly Purified Iron. F. R. HENSEL & E. I. LARSEN. *Metals & Alloys,* Vol. 4, Mar. 1933, pages 37-38. The authors performed dilatometric tests on very pure Fe in a H atmosphere to test the A_3 transformation. Three types of "pure iron" were tested, "as received" and annealed in hydrogen. Temperature of dilatation at A_3 point was unaffected by H treatment in "as received" irons. After annealing 12 hours at 1400° C. samples showed altered dilatation effects at A_3 point and an upward change in temperature of the transformation. Expansion and contraction at Ac_3 and Ar_3 points of 3 types of pure Fe showed varying results. Tests indicate that even purer irons than used in these tests will be necessary to confirm Yensen's hypothesis that the A_3 transformation is caused by impurities. WLC (10)

A Simple Model Explaining the Hardening Effect in Polycrystalline Metals. H. HENCKY. *Journal of Rheology,* Vol. 3, Jan. 1932, pages 30-36. The increase in the stress as a consequence of the progressing plastic deformation has been studied. The strain-hardening is considered to be present in the elastic state as well as in the polycrystalline metals. A hypothetical microstructural model is described and statistically treated. Mathematical deductions are in agreement with the experimental fact that compression makes the material brittle against tensile stresses. GTM (10)

Crystallization of the Benzonaphtol (Sur la Crystalisation du Benzonaphtol—Recherches sur la crystallisation sous le microscope) A. GLAZUNOV & K. SEFL. *Collection of Czechoslovak Chemical Communications,* Vol. 5, May 1933, pages 222-232. The author developed a new method for measuring speed of crystallization and number of centers of crystallization under the microscope. This method can be applied to the study on metals. GTM (10)

"Transformation Points" of Bismuth and Copper (Zur Frage der "Umwandlungspunkte" von Wismut und Kupfer) J. ARVID HEDVALL, R. HEDIN & E. ANDERSSON. *Zeitschrift für anorganische und allgemeine Chemie,* Vol. 212, May 1933, pages 84-90. Dilatometric measurements have led to the assumption of allotropic transformations in Bi at 75° and Cu at 70° C. The irregularity observed in these phenomena is not quite explained, the secondary structure seems to be of importance. Microphotographic or micro-cinematographic methods are suggested for elucidation. 9 references. Ha (10)

A Microscopic Study of Steel with Polarized Light. YAP, CHU-PHAY. *Transactions American Society for Steel Treating,* Vol. 21, July 1933, pages 663-672. 19 references. Photomicrographic studies with polarized light to determine the value of the polarizing microscope in revealing structural phases in quenched and tempered steels in the light of present day knowledge, obtained by other methods, are described. The methods used are those described by Short whose work is recommended for those undertaking the study of metals by this method. 2 steels, of 0.8 and 1.2% C, were heat treated and specially etched and polished. 5 micrographs are shown comparing structure by parallel and polarized light. 2 micrographs of beta martensite and its distinction are given. Troostite, pearlite, and spheroidized cementite are illustrated by both methods. Structural theories are discussed in the light of the information obtained by this study. WLC (10)

Microscopic Studies on Slag Inclusions in Iron and Steel (Mikroskopiska studier över slagginneslutningar i järn och stal) HELGE LÖFQUIST. *Jernkontorets Annaler,* Vol. 117, Jan. 1933, pages 49-112. Microscopic investigations have been made on the slag inclusions in 59 steel samples representing various qualities of open-hearth, converter, electric-furnace steel and wrought Fe. The inclusions were mainly identified by means of known etching methods, or by preparation of synthetic slags. (MnFe)0. Al_2O_3 (spinelle), $3Al_2O_3.2SiO_2$ (mullite), CrS and CrS-Cr0 acetate were identified as slag inclusion. Vanadium nitride, originating from V in the sponge Fe used, was also found. By comparison of the slag diagram with the steel diagram, it has been found that the relation between the content of Si, Mn and added Al practically determines the slag type, which indicates that equilibrium practically prevails between steel and slag. 27 references. HCD (10)

Behavior of Metallic Materials with Static and Dynamic Loading (Das Verhalten metallischer Werkstoffe bei ruhender und wechselnder Beanspruchung) P. LUDWIK. *Zeitschrift für Metallkunde,* Vol. 25, Oct. 1933, pages 221-228. A review, chiefly of Ludwik's work. RFM (10)

Preparation of Non-Liquating Lead-Zinc Alloys. A. A. BOCHVAR & A. YA. ULYANOV. *Tzvetnuie Metallui,* May-June, 1932, pages 28-32. (In Russian) Alloys of Zn with 1% of Pb can be prepared by dissolving the required amount of Pb in the liquid Zn at high temps. However, upon solidification the Pb separates out, and liquation takes place. In order to prepare a uniform alloy free from liquation the authors made 1 to 3% Pb alloys by introducing $PbCl_2$ into molten Zn. Upon solidification the structure was found to be uniform, and the macrographs obtained by etching with HCl showed uniform darkening, indicating the absence of segregation or liquation. The fact that the Pb content of the ingots exceeded the solubility limit indicated that Pb was present as an emulsion. On remelting, part of the Pb separated out. Further experiments indicated that the liquation can be partly prevented by adding small amounts of Mg, and wholly by Cd, Fe and Cu. Tests by dissolving thin rolled plates in a 40-50% soln. of ammonium nitrate showed some traces of coagulation of Pb, although not sufficient to cause liquation. The existence of coagulation was interpreted as indicating the absence of solid solution of Pb in Zn. BND (10)

A Study of Heat Treatment of Alloys of the Aldrey Type. F. A. BORIN, A. A. BOCHVAR, I. P. VELICHKO, K. V. GOREV & M. O. KUZNETSOV. *Tzvetnuie Metallui,* Dec. 1932, pages 94-108. (In Russian) The authors investigated a series of Al-Mg-Si alloys containing from 0.2 to 0.9% Si, 0.36 to 1.54% Mg and 0.2 to 0.3% Fe. The alloys were made and rolled following the usual commercial practice. By combining chemical composition and heat treatment the authors succeeded in obtaining a product of better mechanical properties than had been heretofore possible. A tensile strength of 36 and 38 kg./mm.^{2} was obtained, with corresponding elongation of 15 and 8%. The authors proved that excess Si considerably improved the mechanical properties of alloys with low Mg_2Si content, and that 0.5% excess Si improves the qualities of all the alloys studied; these phenomena are explained on the basis of solubility relations in the alloy. The following optimum conditions for heat treatment of the alloys of the type investigated are recommended: quenching from 525°, followed by tempering at 140°-150° for 48 hrs. or longer. The most beneficial effect of heat treatment on the mechanical properties was obtained in the alloys containing 0.7, 0.75, and 0.90% Si, and 0.40, 0.50, and 0.90% Mg, respectively, or generally, in the Al-Mg-Si alloys with 0.4-0.9% Mg and with the excess of 0.4-0.5% Si over the amount of Si theoretically required for the formation of Mg_2Si. BND (10)

Isothermic Crystallization or Transformation of Given Masses as a Function of Time (Die isotherme Kristallisation oder Umwandlung gegebener Massen in Abhängigkeit von der Zeit) G. TAMMANN. *Zeitschrift für anorganische und allgemeine Chemie,* Vol. 214, Oct. 27, 1933, pages 407-413. The elementary process of crystallization or polymorphous transformation is the formation of germs from which crystallization or transformation spreads; centers can form either at the surface only, or irregularly distributed in the mass. Surface formation occurs in pouring metals into a mold of a temperature below the melting point of the crystallizing mass; at first, the crystallized amount is proportional to time and approaches asymptotically a maximum when the crystals meet in the center of the casting. With irregularly distributed centers, crystallization is at first slow, then increases rapidly, and finally decreases at the end of the crystallization period. Examples are given for monoclinic S, transformation of Al_2Zn_3, and formation of pearlite in Ni or Mn steel containing austenite. 7 references. Ha (10)

Influence of the Lattice Type on the Fine-structure of X-Ray Absorption Constants (Einfluss des Gittertypus auf die Feinstruktur der Roentgenabsorptionskonstanten) J. VELDKAMP. *Zeitschrift für Physik,* Vol. 77, 1933, pages 250-256. Fine structure of elements crystallizing in the same type of lattice was found to be almost identical. This is illustrated by the fine structure of the K-constants of the body-centered elements Cr and Ni, face-centered elements Co, Ni, and Cu, and hexagonal elements Ti and Zn. Ha (10)

Diffraction Patterns Reveal Crystalline Structure of Metals. WM. G. PRAED. *Modern Machine Shop,* Vol. 6, Nov. 1933, pages 7-10, 26. Explains how the crystalline structure can be deduced from X-ray measurement and photomicrographs. Ha (10)

Influence of the α-γ Transformation of an Irreversible Nickel-steel on Crystal Orientation and Tensile Strength (Der Einfluss α-γ Transformation eines irreversiblen Nickelstahls auf Kristallorientation und Zerreissstärke) G. WASSERMANN. *Archiv für Eisenhüttenwesen,* Vol. 6, Feb. 1933, pages 347-351. Tests made on strongly reduced cold-drawn Fe wire with 30% Ni have shown that both the α-γ and γ-α transformation take place as crystallographically regular transformations which are absolutely reversible so that by retransformation the original orientations are always obtained. Heating over 600° C. effects a recrystallization which destroys the regular crystal orientation. The strength of the α-state is considerably greater than that of the γ-state. The increase of strength in the transformation is, however, due not only to the change of the lattice, for the transformation itself has a strengthening effect, although not so strong as that due to the lattice change. If the wire in the γ-state is cooled under load, a jerky flowing occurs at the transformation into the α-state, which is explained as a weakening of the material at the moment of transition from the old into the new lattice. 15 references. Ha (10)

Solubility of the Chemical Compound $MgZn_2$ in Aluminum in Solid State at Different Temperatures (Löslichkeit der chemischen Verbindung $MgZn_2$ in Aluminium im festen Zustande bei verschiedenen Temperaturen) P. SALDAU & M. ZAMOTORIN. *Zeitschrift für anorganische und allgemeine Chemie,* Vol. 213, Aug. 22, 1933, pages 377-382. The solubility of Mg Zn_2 in Al was investigated in the temperature range from 15° to 475° C. At normal temperature it was found to be 1.58% $MgZn_2$. The solubility increases with increasing temperature up to 300° C. where it is 3.57% $MgZn_2$. For higher temperatures, the solubility increases very rapidly, being 13.99% and 24.7% at 400° and 460° C. respectively. The eutectic line is intersected at 475° C. and 30% $MgZn_2$. Ha (10)

Influence of Cooling Velocity Upon the Structure of Eutectics (Der Einfluss der Abkühlungsgeschwindigkeit auf die Struktur der Eutektika) G. Tammann & G. Moritz. *Zeitschrift für anorganische und allgemeine Chemie,* Vol. 214, Oct. 27, 1933, pages 414-426. Very small cooling velocities produce a granular structure, higher velocities a fibrous structure. The ends of the crystal fibers of the different components of a binary, ternary, or multiary eutectic lie on one line. Crystallization velocity of a eutectic is considerably smaller than the smallest crystallization velocity of its components. Formulas for the amount crystallized from the melt are given. Wires were drawn from eutectic melts of Sn-Zn, Cd-Sn, Cd-Pb, Cd-Zn, Pb-Sn. When drawing the wires with a velocity of 5 mm./min. they consisted of fibrous polygons, about 3-6 to the section (of 2 mm. diam.). For drawing velocities of more than 20 mm./min. the wires consisted of fibers which could be observed, after etching, on the surface along the whole length of the wire. Ternary eutectic wires did not show such regular behavior; a quaternary eutectic of 50% Bi, 10% Cd, 13% Sn and 27% Pb (melting point 70°C.) was completely granular when cooled at 10°C./min. The tensile strength of eutectic Cd-Pb-Sn wires, showing Cd and Pb needles parallel to the longitudinal axis in a mass of Sn, was about 1000 kg./cm.^{2} while wires with fibrous polygons showed only 500 kg./cm.^{2}.
Ha (10)

Hardening Processes in Silver-Copper Single Crystals (Aushärtungsvorgänge bei Silber-Kupfer-Einkristallen) P. Wiest. *Zeitschrift für Metallkunde,* Vol. 25, Oct. 1933, pages 238-241. The age-hardening of single crystals of a 5% Ag Cu-Ag alloy was studied by measurements of hardness on a given crystal face and by X-ray determination of a_o, the side of the unit face-centered cell. Aging curves were taken (after quenching) at 350, 375, 400, 420, 425, 445, and 470°. These hardness measurements showed the aging to take place in three stages, the aging curves at the higher temperatures showing 3 maxima. The aging times at which these maxima obtain shorten greatly with increasing temperature. No change in a_o was found during aging until the second maximum was encountered. At 350° 36 hours aging sufficed to pass the first maximum, during which period no change in a_o was found, nor any noticeable broadening of the X-ray diffraction lines. Polycrystalline alloys of the same composition showed a more rapid aging at all temperatures and showed the occurrence of but one maximum in hardness. Followed by discussion.
RFM (10)

The Influence of Carbon on the Thirteen Percent Manganese—Iron—Carbon Alloys. Cyril Wells. *Doctor's Thesis,* Carnegie Institute of Technology, Pittsburgh, 1932, 297 pages. A comprehensive metallographic study. Devotes 26 pages to a review of the existing literature. 1. By the use of thermal, dilatometric and microscopic methods of investigation, the 13% Mn section of the ternary Fe-Mn-C system was determined (C up to 1.57%). 2. The 13% Mn, 0% C alloy does not show a "split" transformation while the high C alloys do. 3. Mn lowers the alpha-to-gamma transformation, while C tends to raise it. 4. The eutectoid composition is lowered from 0.9% to approximately 0.3% C by the addition of 13% Mn. 5. Carbides apparently go into solution faster than they come out. 6. The amount of C retained in the gamma phase depends upon the cooling rate and upon cold work. 7. By special heat treatment the transformation of gamma to epsilon can be made to replace the gamma-to-alpha transformation in a practically carbonless alloy. 8. The formation of epsilon in a high C alloy depends upon the separation of carbides. 9. The epsilon phase cannot be identified microscopically. 10. The transformation of gamma to epsilon is believed to be associated with the formation of a Widmanstätten structure, providing the amount of decomposition is not excessive. CWS (10)

Effect of Thickness on the Crystal Arrangement of Rolled Sheet Aluminum. (Über die Abhängigkeit der Kristallitanordnung in gewalzten Aluminiumblechen von der Blechdicke) G. V. Vargha & G. Wassermann. *Metallwirtschaft,* Vol. 12, Sept. 8, 1933, pages 511-513. Sheet Al was cold rolled to 5 mm. thickness and various layers examined by the X-ray diffraction method. The layers were obtained by machining and etching away parts of one or both sides of the sheet. The orientation in the center of the sheet was entirely different from the surface. The center corresponded to the crystal position (110) parallel to the rolling plane and [112] parallel to the rolling direction. The surface corresponded to the crystal position (100) parallel to the rolling plane and [110] parallel to the rolling direction, but the scattering was much greater in this case. The surface orientation was practically unchanged to a depth of 1.2 mm. and at 1.6 mm. the orientation of the center was obtained. The center orientation of the 5 mm. sheet was obtained throughout in 1 mm. and thinner sheets, the surface being less sharp than the center. These results are similar to those obtained on hard drawn wire. 13 references.
CEM (10)

Selective Lattice Distortion in Wires Under Torsion. W. A. Wood. *Nature,* Vol. 131, June 10, 1933, page 842. X-ray analysis of metal affords a means of detecting the type of internal strain which is accompanied by distortion of the crystal lattice. Since torsional stress can be applied gradually to wire, the rate of broadening of lines can be compared. It was found that the lines exhibit alternating periods in which their definition is partially recovered. The observations justify the view that lattice distortion grows, as stress is applied, to the maximum characteristic of the metal; that the more highly distorted grains disrupt, and then tend to re-crystallize, presumably adopting a more convenient orientation, in a temporarily less distorted state. The latter would coincide with the recovered definition of particular lines.
Kz (10)

Use of the Radioactive Isotope of Lead, Thorium B, in the Study of Metallurgical Problems (Die Anwendung des radioaktiven Bleiisotops Thorium B zur Entscheidung metallkundlicher Fragen) G. Tammann & G. Bandel. *Zeitschrift für Metallkunde,* Vol. 25, July 1933, pages 153-156, 207-209. ThB is prepared by precipitating active deposit from the emanation on metal sample strip connected to the negative pole of a lighting circuit (220 V.) in a glass vessel covered by Cu connected to a positive pole. 1.3 mg. radio-Th precipitates 8×10^{-4} mg. active deposit in 24-48 hours, 10% of which is deposited on metal sample strip; deposit is chiefly ThB. The metal strip is melted under H, polished (not etched) and laid upon a photographic plate to effect photographic registration of α particles. A large number of such contact radiographs are shown: solid Pb dissolves ThB and thus only a general darkening is obtained; Tl is similar; Mg shows stars which disappear to uniform blackening on annealing the sample; Bi, Sn, Sb, Ag, Au, Cu show deposition of ThB in dendrites, Ni at grain boundaries; Cd shows dendritic structure, which on annealing gives way to uniform blackening owing to diffusion, thus showing ThB (and Pb) to be slightly soluble in Cd. Solid solubility of Pb in metals shown in this way is remarkably low, certainly for some metals lower than 1.10^{-6}, though the effect of Pb already present in sample confuses the point somewhat; previous data showing higher solubility of Pb in thin metals are probably wrong. ThB preferentially dissolves in liquid inclusions and thus offers a means for recognizing them even when submicroscopic, such as oxides, sulphides, and phosphides in Fe and steel. The primary casting structure is also shown, by reason of the concentration of ThB between dendrites and at grain boundaries. This concentration is not affected by any transformation in the solid state, thus offering an unaffected record of the original casting structure, as exemplified by the pearlite transformation in steels and transformations in the systems Ag-Zn (β), (Cu-Zn (β), Mg-Cd, Au-Cd. Cast Al shows ThB to be between dendrites; ThB dissolves in the included Al_2O_3. ThB also dissolves preferentially in MgO and thus records this compound in Mg ingots. When liquid Al containing ThB is shaken with liquid Pb, the ThB migrates entirely to the Pb; a similar parting is shown when Al is shaken with Bi, Tl, or Cd, the latter metals taking the ThB; similarly ThB migrates to Pb and Tl from molten Zn. Cast Cd shows ThB at grain boundaries and in dendritic structure; cold rolling elongates these films, and this elongation may be perceived even after lower temperature recrystallization, though high temperature annealing destroys the record by the progressive solution of the ThB in solid Cd. RFM (10)

Contribution to the Study of the Alloys of the Ternary System Magnesium-Copper-Silicon (Contribution à l'étude de la constitution des alliages ternaires magnésium-cuivre-silicium) Albert Portevin & Maurice Bonnot. *Comptes Rendus,* Vol. 196, May 22, 1933, pages 1603-1605. With the object of drafting a ternary diagram for this system, the authors employed Guertler's method of critical compositions which enabled them first to confirm the presence of a ternary compound Mg_2Cu_3Si, melting at 927° C. The presence of this compound having been confirmed, studies were made of other sections of the ternary space model which elicited the fact that there existed (1) a eutectic melting at 565° C., differing but slightly in composition from the compound, Mg_2Cu, and (2) a eutectic containing 16% Mg_2Si and melting at 857° C. Fig. 2 of this paper shows the relationship of these eutectics to the system as a whole; and Fig. 3, the constitution of the magnesium-rich alloys at room temperature. OWE (10)

New Theory of the Mechanism of Formation of Annealed Steels (Nouvelle théorie pour la formation des aciers recuits) J. Seigle. *Genie Civil,* Vol. 103, Oct. 1933, pages 369-373, 400-402. Study of dilatation curves and magnetic properties plotted against the length of specimens showed a gradual transition at the critical points instead of a sharp break. Theory is offered that pearlite does not transform into solid solution instantaneously on heating. Transformation of α into γ iron is progressive, starting with A_1 and occurring both in the free ferrite and pearlite. Pearlite does not transform into solid solution until a quite large amount of γ iron is formed which occurs close to A_3. A small amount of α iron forms at A_3. With its increase cementite cannot remain in solution and is precipitated, carrying with it some α iron. Then the proportion of α iron rises and that of γ drops both in free ferrite and pearlite. JDG (10)

Crystallization of Eutectic Melts (Die Kristallisation eutektischer Schmelzen) G. Tammann. *Zeitschrift für Metallkunde,* Vol. 25, Oct. 1933, pages 236-238. The ends of the two kinds of crystal fibers crystallizing from a eutectic melt advance on a front perpendicular to the direction of heat flow. The more rapid the cooling the thinner these fibers. The decrease in fiber thickness results from the necessity for separation of the two components under the condition of more rapid cooling but constant diffusion velocity. Since one component envelops the other, the diffusion conditions remain uniform. The necessity for separation, requiring diffusion, greatly decreases the apparent crystallization velocity for binary eutectics and more greatly for ternary eutectics. These observations, made primarily on non-metallic systems, are also valid for metallic systems. RFM (10)

A Critical Study of the Iron-rich Iron-Silicon Alloys. Yap, Chu-Phay. *Journal of Physical Chemistry,* Vol. 37, Oct. 1933, pages 951-967. On the basis of the results obtained in the study of some Fe-Si alloys of high purity, by means of the thermoelectric method, electrode-potential measurements and X-ray crystal analysis, it is concluded that Fe_3Si is a compound and not merely a distinguished point on a series of solid solutions. The existence of Fe_3Si_2 and FeSi is also indicated by the electrode potential measurements, without direct evidence, however, of their actual composition. By the thermodynamic method of studying the depression in the freezing point, it is shown that the actual composition of the compound discussed is $(Fe_3Si)_2$ or Fe_6Si_2. The stability of solid solutions, the tendency towards liquation (i.e. unmixing) and formation of regular distribution has been discussed at some length on thermodynamic grounds. Reasons why a solid solution with a regular distribution should be treated as a compound have been advanced. 13 references. EF (10)

Structure of the α-phase of the Ag-Li System (Zur Struktur der α Phase des Ag-Li Systems) Harald Perlitz. *Zeitschrift für Kristallographie.* Vol. 86, Aug. 1933, pages 155-158. The structure of the α-phase in the binary diagram Ag-Li can be interpreted as a γ-brass structure. The cubic lattice involves 52 atoms in the elementary cell which has an edge length of 9.94 A.U. EF (10)

Does Aluminum have a Transformation Point? (Hat Aluminium einen Umwandlungspunkt?) Otto Tiedemann. *Metallwirtschaft,* Vol. 12. Nov. 17, 1933, pages 669-671. The fact that the temperature-physical properties curves of pure Al are straight lines without any irregularities has been set forth by some investigators as proof that Al has no transformation point, but in this author's opinion it does not prove the case. He gives the examples of Fe, Ni, Co, Zn, Cd, Ag, and Cu to show that in some cases changes in the temperature-physical properties curves are not due to transformation points and in some cases transformations occur without noticeable changes in the curves. The author claims that Al does have a transformation point. 14 references. CEM (10)

Use of the Microscope in Study and Control of Electrolytic Coatings (Emploi du microscope dans l'étude et le controle des revetements électrolytiques) Albert Portevin & Michel Cymboliste. *Revue de Métallurgie,* Vol. 30, Aug. 1933, pages 323-348. Defects and properties of electrolytically deposited metallic coatings are reviewed and illustrated with 74 photomicrographs.
JDG (10)

Metallographic Investigation of a Brittle Boiler Tube (Metallographische Untersuchung eines spröden Siederohres) R. St. *Die Wärme,* Vol. 56, Sept. 16, 1933, pages 604-605. Macro- and microstructures of a defective boiler tube end (0.155 C, 0.04 Si, 0.33 Mn, 0.023 P and 0.0285 S). Failure is ascribed to a local superheating of the tube ends after rolling. Normalizing treatment remedied the source of trouble. EF (10)

Electron Diffraction and Structure of Thin Metal Layers (Elektronenbeugung und Struktur dünner Metallschichten) J. A. Prins. *Zeitschrift für Kristallographie,* Vol. 86, Sept. 1933, pages 301-303. Thin layers ($< 0.1\ \mu$) of the face-centered cubic metals Au, Ag, Al deposited in a high vacuum on zapon lacquer carriers yielded ideal powder diagrams with high-speed electrons of 30-60 kV. The hexagonal metals Sb, Cd, Zn, Bi furnish incomplete powder diagrams in case of perpendicular incidence and fiber structures otherwise. New tests on Sn, Ca, Cd, Zn and Mg are discussed at length. EF (10)

Equilibrium Diagram of Iron-Aluminium System. A. Osawa. *Kinzoku no Kenkyu,* Vol. 10, July 1933, pages 277-289. Study of the equilibrium diagram of the Fe-Al system was carried out by means of X-ray analysis and microscopic examination. The diagram from 40 to 52% Fe, which is the most questionable part, was studied closely. Three compounds: $FeAl_3$, Fe_2Al_5, and $FeAl_2$ were detected. These three compounds are very similar, both in X-ray spectral lines and in microstructures. There are four compounds in all, namely, $(FeAl)_n$, $FeAl_2$, Fe_2Al_5 and $FeAl_3$. The first three are formed by the following peritectic reactions:

$$\text{melt} + \delta \text{ solid solution} \rightleftarrows (FeAl)_n \text{ or } \epsilon \text{ solid solution } (1207^\circ \text{ C.})$$
$$\text{melt} + \epsilon \text{ solid solution} \rightleftarrows FeAl_2 \text{ or } \theta \text{ solid solution } (1144^\circ \text{ C.})$$
$$\text{melt} + \theta \text{ solid solution} \rightleftarrows Fe_2Al_5 \text{ or } \eta \text{ solid solution } (1140^\circ \text{ C.})$$

The compound $FeAl_3$ solidifies directly from the melt and forms eutectics with pure Al at 652° C. on one side and with η solid solution at about 1130° C. on the other. KT (10)

Time-Law of the Loss of Strength of Deformed Metals (Ein Beitrag zum Zeitgesetz der Entfestigung verformter Metalle) F. Sauerwald & W. Scholz. *Zeitschrift für Physik,* Vol. 73, 1932, pages 511-525. Increase of strength of metals by upsetting and subsequent loss of strength at the same temperature was investigated. A general law valid for all metals could not be found as some of the curves—loss of strength vs. time—showed inflection points, as for instance, Cu. The explanations of the phenomenon by several investigators are discussed. Crystal recovery and loss of strength by recrystallization seem to be the principal factors. Ha (10)

Electric Conductivity of Cu_3Pd and Cu_3Pt Alloys with Regular and Irregular Distribution of Atoms at Low Temperature (Die elektrische Leitfähigkeit der Cu_3Pd- und Cu_3Pt-Legierungen mit ungeordneter und geordneter Atomverteilung in tiefer Temperatur) H. J. Seemann. *Zeitschrift für Physik.* Vol. 84, Aug. 12, 1933, pages 557-564. Contrary to Cu_3Au alloys, the Cu_3Pd and Cu_3Pt alloys show only a little different decrease of the electric resistance at low temperature for both regular and irregular distribution of atoms. Differences in structure are held responsible for this abnormal behavior. Ha (10)

Crystal Structure of High Speed Steel Carbide (Snabbstalskarbidens kristallstruktur) A. Westgren. *Jernkontorets Annaler,* Vol. 117, Jan. 1933, pages 1-14. Using the X-ray data previously obtained (Westgren & Phragmen, *Transactions American Society Steel Treating,* Vol. 13, 1928, page 539), the space group of the carbide phase in high-speed steel has been found to be O_h^7. The W atoms and associated Fe atoms form a framework of regular and slightly distorted octahedra with shared faces. C atoms are located at the centers of the distorted octahedra. The cavities of the framework are filled with Fe atoms in close-packed tetrahedral arrangement. The most appropriate formula is Fe_3W_3C. The parameters u and v are respectively —0.175 ± 0.01 and 0.195 ± 0.01. 7 references. HCD (10)

X-Ray Examination of Iron Reinforcements in Concrete Constructions (Der Nachweis der Eiseneinlagen in Eisenbeton durch Röntgenstrahlen) Max Widemann. *Der Bauingenieur,* Vol. 14, Sept. 29, 1933, pages 487-490. Among the manifold applications of X-rays for detecting defects and inhomogenities in structures also testing of the iron reinforcements of concrete constructions is to be mentioned. Special reasons may make it necessary to examine important parts of concrete constructions. There is no other method of doing this without destruction of the part tested, than by X-rays. A number of tests is described and discussed. GN (10)

Metallographic Investigation of Tungsten Wire with Addition of Thoria. N. M. Zarubin & A. N. Koptzik. *Tzvetnuie Metallui,* May-June, 1932, pages 59-66. (In Russian.) A discussion of microstructure of tungsten wire with addition of ThO_2, SiO_2, and K_2O. More pores were observed in wires prepared from cheaper grades of W contaminated with Al, Mo, Fe, etc. The number of pores was found to be greater the finer the grain. BND (10)

Studies of Equilibrium in the System Calcium-Sulphur-Oxygen. II. (Gleichgewichtsstudien an den System Calcium-Schwefel-Sauerstoff. II.) R. Schenck & F. Hammerschmidt. *Zeitschrift für anorganische und allgemeine Chemie,* Vol. 210, Feb. 1933, pages 305-312. The insotherms of the bivariant equilibria $4\ CaO + 6\ SO_2 \rightleftarrows 4\ CaSO_4 + S_2$ and $4\ CaS + 2\ SO_2 \rightleftarrows 4\ CaO + 3\ S_2$ were determined. The procedure is described and the results are given in tables. Ha (10)

Manganese-Nitrogen System (Das System Mangan-Stickstoff) R. Schenck & A. Kortengraeber. *Zeitschrift für anorganische und allgemeine Chemie,* Vol. 210, Feb. 1933, pages 273-285. The diagram of the Mn-N system was investigated. The equilibrium isotherms are very irregular below 800° C. At 800° C. the miscibility becomes total. The ϵ-phase is strongly ferromagnetic, the ζ-phase not at all. The test results are given in detail. 14 references. Ha (10)

Formation of Solid Solutions of Mono- and Polycrystalline Material (Ueber die Mischkristallbildung bei ein- und vielkristallinem Material) E. Schmid & G. Siebel. *Zeitschrift für Physik,* Vol. 85, Aug. 29, 1933, pages 29-35. Monocrystals and polycrystals are compared with respect to grain size and saturation limit. The solid solutions of Al-Mg, Zn-Mg and Ag-Cu did not show a measureable difference in their lattice constants between mono- and polycrystals; also, the saturation limit was the same for Al-Mg and Ag-Cu. Preparation of crystals is described. 15 references. Ha (10)

Atomic-, Fusion- and Transformation Heats of Gallium, Indium and Thallium (Atom-, Schmelz- und Umwandlungswärmen von Gallium, Indium und Thallium) W. A. Roth, Ingrid Meyer & H. Zeumer. *Zeitschrift für anorganische und allgemeine Chemie,* Vol. 214, Oct. 7, 1933, pages 309-320. Specific heats in solid and liquid states, fusion heats, and melting points were determined for chemically pure materials. The entropy change in melting, Q/T, is not constant for these metals. Ha (10)

Roentgenographic Investigation of Molten Metals and Alloys. I. (Ueber die röntgenographische Untersuchung schmelzflüssiger Metalle und Legierungen. I.) F. Sauerwald & W. Teske. *Zeitschrift für anorganische und allgemeine Chemie,* Vol. 210, Feb. 1933, pages 247-256. A high vacuum camera and a method are described which make the X-ray examination of molten metals possible under protection against oxidation. The results of measurements of change of volume, atomic radius and lattice constants are tabulated for Ti, Pb, Na, K, Hg, Sn and Ga. 21 references. Ha (10)

An Integrating Photometer for X-ray Crystal Analysis. B. W. Robinson. *Journal of Scientific Instruments,* Vol. 10, Aug. 1933, pages 233-242. Description of a photoelectric photometer designed primarily for the measurement of integrated X-ray intensities but adaptable to almost any form of X-ray photometry. Simple and comparatively cheap to construct. 6 references. RAW (10)

Anomalous Dispersion of X-rays by Copper (Anomale Streuung von Roentgenstrahlen an Kupfer) A. A. Rusterholz. *Zeitschrift für Physik,* Vol. 82, May 15, 1933, pages 538-550. The dispersion constants of Cu in the K-range were measured and compared with those of Al and Zn. Ha (10)

Lattice Constant as Function of Hydrogen Concentration in the System Palladium-Hydrogen (Die Abhängigkeit der Gitterkonstante von der Wasserstoffkonzentration im System Palladium-Wasserstoff) G. Rosenhall. *Annalen der Physik,* Series 5, Vol. 18, Sept. 19, 1933, pages 150-154. The lattice constant was found to be constant for a ratio of H/Pd up to 0.64, for greater ratios it increased linearly with the concentration. Ha (10)

Applicability of Non-destructive Testing Methods in Bridge Building with Special Regard to Radiography (Anwendbarkeit zerstörungsfreier Prüfverfahren im Brückenbau unter besonderer Berücksichtigung der Röntgendurchstrahlung) W. Rosteck. *Glasers Annalen,* No. 15, 1933, pages 74-78; Dec. 1, 1933, pages 89-92. Non-destructive testing methods are described and their applicability is critically discussed. The X-ray equipment of the Reichsbahnzentralamt für Bau- und Betriebstechnik is described and operation of X-ray equipment on the building site is considered. Several examples of investigations are shown. GN (10)

Metallography of Automotive and Aircraft Valves. E. D. Viers. *Fuels & Furnaces,* Vol. 11, Mar.-Apr. 1933, pages 67-69; July-Aug. 1933, pages 139-142; Sept.-Oct. 1933, pages 171-174. Necessity for metallographic examination in valve manufacture is pointed out and several instances described where serious defects were detected. Influences on structure and stresses in valves exerted by methods of heating and cooling of forgings, effects of machining and marking, and deformations by heating, are described. Causes and means of prevention of valve stem and tip wear, burning, scaling, and other failures are discussed. Improper heat treatment can be assumed as the cause of most failures. Inclusions, scratches, sharp shoulders, tool marks, or corrosion commonly lead to fatigue failure. Ha (10)

Electron Emission of Metals under the Action of Monochromatic X-rays (Die Elektronenemission der Metalle unter Einwirkung monochromatischer Röntgenstrahlen) Hermann Hase. *Zeitschrift für Physik,* Vol. 80, Feb. 16, 1933, pages 670-689. The electron emission of Fe, Cu, Mo, Ag, Sn, Ta, W, Au, Pb and Bi was determined for monochromatic X-rays. Results were found to be in good agreement with the theory of Kuestner. The maximum of electron emission takes place, for all elements, at about 0.19 A. U. The discontinuity between the K and L series of the emission increases with the atomic number of the irradiated element. 28 references. Ha (10)

X-Ray Analysis of Iron-Tin Alloys. W. F. Ehret & A. F. Westgren. *Metal Industry,* London, Vol. 42, June 16, 1933, pages 611-613. See *Metals & Alloys,* Vol. 4, Nov. 1933, page MA 348. Ha (10)

Efficiency of X-Ray K-Fluorescence Radiation for Light Elements (Der Nutzeffekt der Röntgen-K-Fluoreszenz-Strahlung bei leichten Elementen) Martin Haas. *Annalen der Physik,* Series 5, Vol. 16, Feb. 1933, pages 473-488. The ratio of the number of excited atoms to the number of emitting atoms, called the efficiency of the X-ray radiation, was investigated in the K-fluorescence range for Mg, Si, S, Cl, Ca and Cr. The tests and measurements are explained in detail. Ha (10)

Mutual Solubility of Lead and Bismuth Melts and Molten Zinc (Ueber die gegenseitige Löslichkeit von Blei-bez. Wismutschmelzen in geschmolzenem Zink) Karl Haas & K. Jellinek. *Zeitschrift für anorganische und allgemeine Chemie,* Vol. 212, June 20, 1933, pages 356-361. An apparatus was developed to determine the partial miscibility of metals. Test results for Pb with Zn and Pb with Bi are given. Ha (10)

Crystal Chemistry of Metals (Kristallchemie der metallischen Stoffe) U. Dehlinger. *Die Naturwissenschaften,* Vol. 21, Feb. 10, 1933, page 138. Paper before Deutsche Mineralogische Gesellschaft, Mainz, Sept. 26, 1932. Crystal types with metallic conductivity, the space lattice of which possesses the coordination number 8 or 12, exhibit an almost 100% metallic linkage. Comparing their properties with those of substances whose structure is more or less influenced by homöopolar linkage as for instance Cd, Zn, Sn, Bi, the typical properties of metallic linkages can be drawn. While the former group (Cu, Ag, Au, Al) is completely plastic in the pure undistorted state, a light deviation from the high coordination (Mg) results in a distinct yield point under comparable degrees of purity. The structure of α and β Mn, γ brass, etc. proves that the high symmetry of the metallic linkage can still exist when the individual coordination of the atoms becomes distorted. In case of allotropic changes accompanied by a change of the coordination number ($\beta \longrightarrow \gamma$ Fe, cubic $\longrightarrow$ tetragonal Au-Cu) the density remains practically constant, contrary to the atom radius with reference to heteropolar bondage. Alloy phases whose structure points at an almost complete metallic linkage disobey the valency rules of classical chemistry with respect to their composition. EF (10)

The Dilatation of Tin Crystals (Ueber die Dehnung von Zinnkristallen) J. Obinata & E. Schmid. *Zeitschrift für Physik,* Vol. 82, Apr. 1933, pages 224-234. Dilatation of crystals of white Sn was investigated from the crystallographic viewpoint by determining the translation elements and from the mechanical viewpoint by determining the critical shearing strength and strengthening curves. The 2 most important translation systems are t = [001] and T = {100} and {101} respectively; it depends on the direction of stress in which of the 2 systems translation occurs. The critical strength of the different translation systems is of about the same order. A transformation point of white Zn at elevated temperatures does not seem to exist. Temperature has little influence on the critical shearing strength. Ha (10)

Precision Measurements of Crystal Parameters. E. A. Owen & E. L. Yates. *London, Edinburgh & Dublin Philosophical Magazine & Journal of Science,* Ser. 7, Vol. 15, Supp. No., Feb. 1933, pages 472-488. The lattice parameters of Au, Pt, Pd, Rh, Pb, Ir, Fe, Al, Cu, Ag, each possessing cubic symmetry, were measured by a precision X-ray method. Four of the elements were spectroscopically pure and the others were of a high degree of purity. The lattice parameters at 18° C. were found to be as follows: Au 4.0699 ± 0.0003A. U.; Pt 3.9158 ± 0.0003; Pd 3.8824 ± 0.0003; Rh 3.7957 ± 0.0003; Pb 4.9396 ± 0.0003; Ir 3.8312 ± 0.0005_5; Fe 2.8607_5 ± 0.0002; Al 4.0406_5 ± 0.0002; Cu 3.6077_5 ± 0.0002; Ag 4.0772_4 ± 0.0002. The values have been corrected for deviation from Bragg's Law. The densities of the materials at 0° C. and 20° C. were calculated from the above parameters. These results are presented in extensive tables. RHP (10)

Present-day Problems of Metallurgy. Georg Masing. *Transactions American Institute Mining & Metallurgical Engineers, Institute of Metals Division,* Vol. 104, 1933, pages 13-47. The most recent advances in physical metallurgy are discussed and the unsolved problems pointed out. The subjects discussed include parting limits, precipitation hardening, and transformations. 30 references. JLG (10)

On the Equilibrium Diagram of Al-Mg System. M. Kawakami. *Kinzoku no Kenkyu,* Vol. 10, 1933, pages 532-554 (In Japanese). By means of the thermal analysis, microscopic examination, X-ray analysis, and measurement of single-electrode potential and electric resistance, the equilibrium diagram of the Al-Mg system was determined. In this system, there exist three intermetallic phases. Al and Mg have mutual solubilities, forming α- and ϵ-phases, respectively. The intermetallic phases, β, γ, and δ, consist mainly of compounds, Al_8Mg_5, AlMg and Al_3Mg_4 respectively. The ϵ-phase has been found in the present investigation; this phase is formed by the peritectic reaction: melt $+ \delta \rightleftarrows \gamma$. KT (10)

Segregation in a Silver Ingot (Seigerung in einem Silberblock) O. Bauer & E. Deiss. *Zeitschrift für analytische Chemie,* Vol. 92, No. 5/6, 1933, pages 161-165. An ingot of 83.5% Ag and 16.5% Cu was examined by subdividing into 10 zones from the center to the outer surface with regard to distribution of Ag; considerable segregation was found in the top center: 87% Ag. If exact analysis of an ingot is to be made it is recommended to mix the different samples taken from an ingot, remelt them and granulate them by pouring into water; the metal now solidifies homogeneously and a reliable analysis can be made. Ha (10)

Direct Determination of Cementite in Iron (Beitrag zur direkten Zementitbestimmung im Eisen) W. Baukloh & O. Kloeckl. *Zeitschrift für anorganische und allgemeine Chemie,* Vol. 215, Dec. 1, 1933, pages 345-354. The usual method for determining cementite in Fe-C alloys is that of determining the difference between total C and graphite contents of the Fe. Tests to find a method of direct determination were developed, but proved to be not successful on account of the different resistance of the constituents to the acids used for dissolving the sample; the composition of the residues and of the gases developed during dissolution showed a very great dependency on both time and temperature of dissolution, and granular pearlite was more resistant to the dissolving acid than laminated pearlite or troostite. Ha (10)

Magnetic and Dilatometric Investigations on Steel Hardening (Magnetische und dilatometrische Untersuchungen zur Stahlhärtung) W. Jellinghaus. *Zeitschrift für technische Physik,* Vol. 14, No. 6, 1933, pages 229-230. A brief review of the present status of explanations for the hardening process of steels. It is now assumed that the transformation starts from germs which originate by diffusion during the segregation of ferrite and carbide. The theory of equilibrium will hardly be able to elucidate these problems, as it deals only with final conditions. Crystallographic examination will be much more apt to solve the hardening problem, because intermediary conditions can be studied. Ha (10)

X-ray Investigation of the Iron-Selenium System (Röntgenuntersuchung am System Eisen-Selen) Gunnar Hägg & Anna-Lisa Kindström. *Zeitschrift für physikalische Chemie,* Abt. B, Vol. 22, Sept. 1933, pages 453-464. In the Fe-Se system, 2 intermediary phases occur at 50 atomic % Se. At low temperatures, a phase of the PbO type exists; this changes into the NiAs structure at elevated temperatures. By increasing the Se concentration, the PbO structure is eliminated and the phase of NiAs structure becomes stable at room temperature. Further increase of the Se content results in a monoclinic deformation which attains a maximum at 55-56 atomic % Se. The homogeneity limit of alloys richest in Se was established to be 57.5 atomic % Se. The space-lattice contraction is steady up to this concentration. Comparison of densities evaluated from X-ray data and direct measurements indicates the occurrence of a solid solution of the "subtraction type," i.e., the solution of Se in FeSe is accompanied by a lattice contraction due to the presence of unoccupied places in the Fe lattice. No stable intermediary phase could be discovered between 57.5 and 100 atomic % Se. EF (10)

An X-ray Investigation of the Copper-Aluminium Alloys. A. J. Bradley & Phyllis Jones. *Engineering,* Vol. 135, Mar. 24, 1933, page 327. Brief abstract of paper read before Institute of Metals, Mar. 1933. See *Metals & Alloys,* Vol. 4, Nov. 1933, page MA 348. LFM (10)

PROPERTIES OF METALS & ALLOYS (11)

Magnetostriction. III. Alfred Schulze. *Zeitschrift für Physik*, Vol. 82, May 23, 1933, pages 674-683. Experiments with monocrystals of Fe and Ni show that the length changes in a magnetic field in the same manner as the electric resistance. These values increase with increasing mechanical stress of the material. The tests are reproduced in curves and are fully described. Ha (11)

Elastic After Effects in Metals. M. F. Sayre. *Physikalische Berichte*, Vol. 13, Aug. 1, 1932, page 1384. (In English). Elastic after effects can occur due to plastic deformation of individual crystals which continue to flow until the surrounding crystals elastically absorb the stress. The author shows that the after-effect due to thermal effects, which are measurable in case of purely elastic deformations, cannot be disregarded. EF (11)

Non-Ferrous (11a)

A. J. PHILLIPS, SECTION EDITOR

Strength and Aging Characteristics of the Nickel Bronzes. E. M. Wise & J. T. Eash. *Metals Technology*, Jan. 1934, Technical Publication No. 523, 25 pages. The alloys studied contained as much as 12.5% Sn and as much as 15% Ni. Sand castings were made and tested after different heat treatments. Some alloys were rolled, heat treated, and tested. Properties of alloys of constant cost were considered, and for sand castings an alloy with 5% Sn and 8% Ni was found to be good. It can be hardened by a precipitation treatment to develop a tensile strength in excess of 90,000 lb./in.^{2} with an elongation of 15%. Considerable data on alloys with 8% Sn and 7.5% Ni are reported. The influence of small amounts of other elements on this alloy was studied, but additive elements did not improve its properties. Wrought heat-treated alloys had tensile strengths as high as 135,000 lb./in.^{2}, and samples cold rolled and then hardened by precipitation had strengths as high as 170,000 lb./in.^{2} The precipitation hardening treatment consisted in quenching from 1400° F. and reheating to temperatures in the neighborhood of 600° F. 9 references. JLG (11a)

Strength of Hiduminium R.R. 56 Alloy. *Metal Industry*, London, Vol. 42, Apr. 21, 1933, page 427. This Al alloy, composition of which is not given, has a weight of 60% of steel (of 7.9 gravity). For beams of equal weight the alloy is said to be 2.78 times as stiff and 3.88 times as strong as a steel beam of 35 tons/in.^{2} tensile strength and 30,000,000 lbs./in.^{2} Young's modulus. For sheets of equal weight the alloy is 6.6 times as strong and 7.9 times as stiff as steel. Ha (11a)

Physical Properties and Electrical Conductivity of Aluminum Alloys for Overhead Transmission Lines (Mechanische eigenschappen en elektrisch geleidingsvermogen van aluminiumlegeeringen voor openluchtleidingen) *Polytechnisch Weekblad*, Vol. 27, Aug. 24, 1933, page 532. Diagrams show the changes of T.S. and conductivity of Aldrey (0.61% Si, 0.26% Fe, 0.45% Mg, balance Al) in correlation to age-hardening at room temperature, at 155° C., and after cold deformation. Brief mention is made of Hoopes' refining process of Al yielding 99.983% pure Al with a resistance of only 37.84 m./ohm mm.^{2} WH (11a)

Te-Pb Alloys (Telluur-lood legeeringen) *Polytechnisch Weekblad*, Vol. 27, Sept. 7, 1933, page 575. Note on 0.02-0.085% Te bearing Pb which displays higher stability towards boiling conc. H_2SO_4 than hard lead. WH (11a)

Hydronalium, a New Aluminium Alloy. *Engineering Progress*, Vol. 14, July 1933, pages 130-131; Aug. 1933, page 163. "Hydronalium" consists of Al alloyed with 5 to 15% Mg and a trace of Mn. These alloys resist corrosion, do not require any heat treatment for ageing, are best joined by riveting with rivets of the same alloy, oxy-acetylene welding may be used for short length of welds giving a tensile strength of 85 to 95% that of the material, spot-welding is used for longer joints and gives corresponding strength. The part published in Aug. 1933 is a correction of the tensile properties given in the July 1933 issue. RHP (11a)

Beryllium in America. *Engineer*, Vol. 155, June 23, 1933, page 624. Brief note outlining use of Be-Cu alloy in the United States. A few figures are given showing the changes in tensile properties of the alloy produced by the proper heat treatment. LFM (11a)

Hydronalium, A New Light-Metal Alloy (Hydronalium, eine neue Leichtmetall-Legierung) DeRidder. *Autogene Metallbearbeitung*, Vol. 27, May 15, 1933, pages 153-154; *Automobiltechnische Zeitschrift*, Vol. 36, May 25, 1933, page 269. Hydronalium is an alloy of Al with 5.% or 9% Mg. Specific gravity varies from 2.63-2.59; castings have a tensile strength of 17-19 kg./mm.^{2} at 3-12% elongation, forged material 35-44 kg./mm.^{2} at 22-12% elongation. It is less attacked by sea water than pure Al, and the corrosion resistance for soda and soap solutions is considerably greater than in other light metals. At 350-450° C. it is easily shaped. Joints can be made both by gas-fusion welding and electric resistance welding, the solidification interval is only 50-70° C. against 150 for steel. The welding rod should be of the same material as the pieces to be welded. The expansion coefficient is twice that of steel, 24 x 10^{-6}. The strength of gas-fusion welds is: for sheets, 85-95%; for pressed parts, 60-70% and for castings, 100% that of the original strength. The alloy is made by the I. G. Farbenindustrie. Ha (11a)

Contribution to Determination of Reflecting Ability of Metals in Visible and Ultraviolet Spectrum (Ein Beitrag zur Bestimmung des Reflexionsvermögens von Metallen im Sichtbaren und im Ultraviolett) K. von Fragstein. *Annalen der Physik*, Series 5, Vol. 17, May 1933, pages 1-21. The reflective power for rays in the visible and ultraviolet part of the spectrum was spectrophotometrically determined for several kinds of steels, Ag, Al-Mg alloys, Te, Ta, pyrite and galena. A systematic relation between optic constants and chemical composition could not be stated. Ha (11a)

Hall Effect and Resistance of Hydrogen Saturated Palladium-Silver and Palladium-Gold Alloys (Halleffekt und Widerstand von wasserstoffbeladenen Palladium-Silber- und Palladium-Goldlegierungen) J. Wortmann. *Annalen der Physik*, Series 5, Vol. 18, Oct. 1933, pages 233-250. Pd-Ag alloys show parallelity of Hall effect and photo- and thermo-electric behavior with a maximum at 30% Ag. Pd-Au shows a maximum of Hall effect at 65% Au and of photo- and thermo-electric behavior at 40% Au. Absorbed H increases photo- and thermo-electric and reduces Hall effect. Tests are given in detail. Ha (11a)

Cobalt and Its Uses. L. Sanderson. *Sands, Clays & Minerals*, Vol. 1, July 1933, pages 51-57. Brief historical notes on discovery and development; the various Co ores and places of their deposits are reviewed, the most important being at present at Cobalt, Ontario, Canada, where an average of 1,000 tons/yr. were produced during the last 6 years. Methods of mining and principal uses in steel and ceramic industries are discussed. Ha (11a)

The Diffusion of Metals in Mercury (Zur Diffusion von Metallen in Quecksilber) F. Weischedel. *Zeitschrift für Physik*, Vol. 85, Aug. 29, 1933, pages 29-35. The diffusion of Zn and Cd into Hg was determined by a new method which gave continuous values for the whole process from the beginning to the end of diffusion. The time-diffusion rate was determined by measuring the electric resistance of different layers. Ha (11a)

Some New Aluminum Alloys (Über einige neuere Aluminiumlegierungen) Edmund Richard Thews. *Chemiker-Zeitung*, Vol. 57, June 28, 1933, pages 501-502. Hydronalium contains 7-9% Mg and some Si and Mn, balance Al, and has good corrosion resistance against atmosphere, also sea water, soda, and soap solutions. It has tensile strength 31-40 kg./mm.^{2} 22-4% elongation and can be formed cold, welded, and riveted. BS-Seewasserlegierung, containing 7.5-9.5% Mg, .2% Si, and .2-.6% Mn, has similar mechanical properties. Duranalium is also similar. Mangal contains 1.5% Mn, balance Al, is furnished in sheet form, and has very good corrosion resistance. It has tensile strength 9-25 kg./mm.^{2}, 30-2% elongation, 20-60 Brinell hardness. Pantal contains .8-2% Mg, .4-1.4% Mn, .5-1% Si, .3% Ti. It has tensile strength 11-42 kg./mm.^{2}, 25-2% elongation, 30-120 Brinell in sheet form and 14-25 kg./mm.^{2} tensile strength, 8-.5% elongation, 40-120 Brinell in sand cast form. Bondur, containing 4.2% Cu, .3-.6% Mn and .5-.9% Mg, is similar to Duralumin. It is usually heat treated. Its corrosion resistance is not very good and electrolytic action takes place when it is in contact with brass or Cu. It has 16-60 kg./mm.^{2} tensile strength, 21-2% elongation and 105-150 Brinell. Albondur is Bondur clad with pure Al, usually 5%. It has good corrosion resistance. CEM (11a)

The Metallurgy and Uses of Zinc. Stanley Robson. *Metal Industry*, London, Vol. 42, Apr. 7, 1933, pages 369-372; Apr. 14, 1933, pages 397-400; Apr. 21, 1933, pages 421-424; May 5, 1933, pages 475-478. An exhaustive review of methods of producing pure Zn, qualities, uses of Zn particularly as coating for steels. Illustrations are shown and alloys often used enumerated. Ha (11a)

Manganese, Its Occurrence and Uses. R. Ridgway. *Metal Industry*, London, Vol. 43, July 28, 1933, pages 83-84. Mn-bearing minerals are enumerated, distribution of deposits, and chemical and physical properties described. The principal uses are metallurgical and chemical. Statistics of world output are given. Ha (11a)

Four Zinc Alloys for Die Castings. W. M. Pierce. *Product Engineering*, Vol. 4, July 1933, pages 263-266. Compositions are given. Ha (11a)

Preparation of Boron and Some of Its Compounds with Nitrogen and Carbon (Die Darstellung von Bor, sowie einiger seiner Verbindungen mit Stickstoff und Kohle) E. Podszus. *Zeitschrift für anorganische und allgemeine Chemie*, Vol. 211, Mar. 1933, pages 41-48. A process is described by which compounds of B and N, and B and C were obtained synthetically from finely ground anhydrous boric acid and gaseous NH_3. The boro-carbides (apparently B_3C) were as much as 14 times harder than carborundum crystals. Ha (11a)

The White Alloys of Tin. The Bearing Metals. *Tin*, May 1933, pages 15-18. Requirements of bearing metals are discussed and Sn-base and Pb-base alloys described from the point of view of their satisfying these requirements. The most common compositions are reviewed. All white metals can be die-cast very successfully and are therefore well adapted for small mass production bearings. Ha (11a)

Susceptibility and Electric Conductivity of Copper-Manganese Alloys (Suszeptibilität und elektrische Leitfähigkeit von Kupfer-Mangan-Legierungen) S. Valentiner & G. Becker. *Zeitschrift für Physik*, Vol. 80, Feb. 23, 1933, pages 735-754. Magnetic susceptibility and electric conductivity of Cu-Mn alloys were determined in the range from room temperature to that of liquid air. The law of Curie-Weiss with respect to dependence of susceptibility on temperature was found valid for temperatures to —60° C. The alloy with 1 Mn atom and 3 Cu atoms shows at all temperatures a maximum susceptibility. Tables and formulas for resistance and temperature coefficients are developed. 18 references. Ha (11a)

Technical Production of Rhenium and Gallium and Some of Their Compounds (Die technische Gewinnung des Rheniums und Galliums und einige ihrer Verbindungen) W. Veit. *Angewandte Chemie*, Vol. 46, Apr. 15, 1933, pages 216-218. The cupriferous slate of Mansfeld (Germany) contains 1 part in 5,000,000 parts Re which is extracted as potassium perrhenate from which metallic Re is produced. At present about 150 kg. Re-metal/year can be produced. Industrial application is seen, at present, perhaps as catalyzer and as alloy with rare metals. Ga is made from the same source and is present in about the same proportion as Re. Metallic Ga is produced from gallium oxide. The metal is liquid at about 30° C. and boils at 2000° C. It is used in place of Hg in thermometers for 500° to above 1,000° C., and in dentistry where metallic amalgams are made for tooth fillings. Unlike Hg it is non-poisonous. Ha (11a)

Secondary Electron Emission of Nickel and Ferromagnetism (Sekundäre Elektronenemission von Nickel und Ferromagnetismus) P. Tartakowsky & W. Kudrjawzewa. *Zeitschrift für Physik*, Vol. 75, 1932, pages 137-142. The secondary electron current emitted when Ni is bombarded with "primary" electrons is studied as a function of temperature of Ni. A distinct discontinuity occurs at the temperature of the Curie point of Ni. It is concluded that the ferromagnetism is bound up with the conducting electrons, and that these and the secondary electrons must be considered as identical. Ha (11a)

Light Absorption of Metals (Über die Lichtabsorption der Metalle) A. Smakula. *Physikalische Zeitschrift*, Vol. 34, Nov. 1, 1933, pages 788-790. Only 3 metals have been shown, theoretically, to possess great transparency; these are Cu, Ag, and Au. The experiments were aimed to determine whether these metals showed greater transmission of light of short wave lengths, and whether other metals show this characteristic. Reflection was determined in air; transmission in vacuum. The metals investigated were: Cu, Ag, Au, Al, Sn, Pb, Bi, Cr, and Mn. Curves report the absorption spectra of these metals in the solid state. Bibliographical foot-notes. RRS (11a)

A Practical Foundry Test on the Effect of Phosphorus, Aluminum and Silicon on Leaded Bronze. Harold J. Roast. *Transactions American Foundrymen's Association*, Vol. 41, 1933, pages 82-97; *Metal Industry*, London, Vol. 43, July 14, 1933, pages 33-36; Nov. 3, 1933, pages 443-446. Tests were undertaken to determine the effects of small quantities of P, Al and Si on the fracture and outward appearance of leaded bronze castings. Phosphorus was not harmful while as much as 0.05% Si or Al was detrimental to the castings. Ha+CHL (11a)

Some Effects of the Addition of Tellurium to Lead. W. Singleton & Brinley Jones. *Metal Industry*, London Vol. 42, Mar. 17, 1933, pages 300-303. See *Metals & Alloys*, Vol. 4, Oct. 1933, page MA 335. Ha (11a)

Recent Advances in the Field of Silumin Castings. G. Sachs. *Metallgesellschaft*, No. 7, Mar. 1933, pages 21-29. (In English). The use of silumin, Cd-Al-Si alloy, has greatly increased in Germany, particularly because of its excellent casting qualities and good mechanical properties. A great many examples of machine and automobile parts are illustrated and a table showing the properties of some silumin castings is given. Ha (11a)

The Elastic Properties of Gold-Silver Single Crystals (Die elastischen Eigenschaften von Gold-Silber-Einkristallen) H. Röhl. *Annalen der Physik*, Series 5, Vol. 16, Apr. 1933, pages 887-906. Elastic properties in the system Au-Ag are very anisotropic, just as in the pure components. Elongation and torsion modulus, Poisson's constant and velocity of sound were determined. 39 references. Ha (11a)

"Elmet" Metals (Les Métaux "Elmet") *Revue Générale de l'Electricité*, Vol. 34, July 22, 1933, pages 89-90. 2 new alloys are described for particular use, such as contacts in electrical circuits and similar purposes where high temperature resistance and hardness are required. The one consists of very finely divided W which later is mixed with pure Cu and sintered, the other mixed with pure Ag; they are called "Rotung" and "Silvung" respectively. Density varies from 14.5 to 15.5 according to the content of W, the Brinell hardness is about 110-120 and the conductivity about ½ that of Cu. The new material can be welded and soldered. Ha (11a)

Hydronalium, a Light Metal Alloy of High Corrosion Resistance (Hydronalium, eine Leichtlegierung hoher Korrosionsbeständigkeit) W. Schultze. *Werft, Reederei und Hafen,* Vol. 14, Oct. 1, 1933, page 280; *Farbenzeitung,* Vol. 38, Oct. 21, 1933, page 1531; *Forschungen und Fortschritte,* Vol. 26, Sept. 10, 1933, pages 386-387. Hydronalium weighs 6-8% less than Duralumin due to an addition of 5-15% Mg (besides small amounts of Mn) to Al, is highly resistant towards sea water corrosion as compared with Duralumin 681 A and soft Al of 99.5% purity, requires no heat treatment, is jointed by riveting, gas or electric welding, and exhibits a Cr-like luster in the polished state. The alloy is utilized for fittings in the automobile and ship-building industries.
EF+WH (11a)

Herculoy, A Cu-Si-Sn-Zn Alloy. R. A. Wilkins. *Metals & Alloys,* Vol. 4, Aug. 1933, pages 123-126. Describes a commercial alloy of 3.25% Si, 1.5% Zn and 0.5% Sn with Cu which offers the desirable corrosion resistance properties of Cu with mechanical properties comparable with steel. The availability of the alloy in the form of sand castings, rolled rod and sheet are described with the properties obtainable in these conditions. Various applications are described and the thermal and electrical characteristics given. WLC (11a)

Anodic Behavior of Cobalt (Ueber das anodische Verhalten des Kobalts) Konrad Georgi. *Zeitschrift für Elektrochemie,* Vol. 39, Apr. 1933, pages 209-219. The anodic behavior of Co is similar to Ni; it is soluble only at a limited number of places on its surface, but these places have a different size from those on the Ni surface as they offer less resistance to penetrating anions; the size of the anions determines the passivation of Co. The anodic dissolving process can be assumed, similar to Ni, to be represented by $Me + 2H' \longrightarrow Me'' + 2H$, and its velocity is given by number and size of the easily soluble places at the metal surface and by the size of the anions and H'-concentration. Ha (11a)

Alloys of Platinum with Cobalt (Ueber Legierungen von Platin mit Kobalt) W. A. Nemilow. *Zeitschrift für anorganische und allgemeine Chemie,* Vol. 213, July 21, 1933, pages 283-291. Pt-Co alloys were investigated; melting points, microstructure, hardness values, electric resistances were determined. Results are given in curves. System Co-Pt is very similar to Ni-Pt; both represent at high temperatures a continuous series of solid solutions. Only the Pt-Co alloys with high Pt content can be used industrially as the other alloys do not stand mechanical working. Ha (11a)

Aluminum Foils (Aluminiumfolien) *Aluminium,* Vol. 15, July 31, 1933, pages 4-5. Field of application in the packing industry; about 40% of Al produced is used for foils. Properties as compared with Sn-plated Pb foil are:

	Aluminum foil		Lead foil, tinplated
	Soft	Hard	
Thickness in 10^{-3} mm.	150-35	50-35	35
Tensile strength, kg./mm.^{2}	7.5-7.7	18.4-20	3.07
Elongation %, in 100 mm.	9.5-8.2	1.9-2.22	10.65

Ha (11a)

Zinc-Aluminum Alloy as High-Grade Bearing Metal (Zink-Aluminium-legierung als hochwertiges Lagermetall) *Aluminium,* Vol. 15, Sept. 15, 1933, pages 3-4. A Zn-Al alloy containing 8-18% Al, 1% Cu maximum and 0.001-1.0% Ni is said to be a very good bearing metal which has the advantage over the ordinary Sn or Pb white metal alloys that it can be used also at elevated temperatures and over P-bronzes that they become soft enough at these temperatures to prevent an excessive increase of pressure at some place of the gliding surface. The Brinell hardness at 15° C. was 75 against 16-30 for white metal and 110 for P-bronze; at 150° 108 while white metal is too soft and P-bronze is still about the same. At 200° the material had still a hardness of 22. Directions for preparing the alloy are given. Ha (11a)

The Aluminium Industry in Scotland. *Industrial Chemist,* Vol. 9, Aug. 1933, pages 271-274. A detailed abstract of a paper read by George Boex before the Institution of Mechanical Engineers. Discussion of the production of alumina from bauxite ore, the production of carbon electrodes and the electrolytic production of the metal. RAW (11a)

Beryllium in the Foundry (Il Berillio in Fonderia) *L'Industria Meccanica,* Vol. 15, Sept. 1933, pages 679-681. Reviewing uses and physical properties of Be alloys and Be as deoxidizer from 2 recent publications by J. Laissus and E. F. Cone. Ha (11a)

Beryllium Copper—a New High-Strength Alloy. *Machinery,* (N. Y.), Vol. 39, Jan. 1933, page 365. A new product developed by the American Brass Co. This alloy may contain from 1 to 2.25% Be with the balance Cu. Principal advantages are high tensile strength, high fatigue limit, hardness, electrical and thermal conductivity, and corrosion resistance. RHP (11a)

Field for Non-Ferrous Metals is Broadened by Active Research. *Machinery,* (N. Y.), Vol. 39, Feb. 1933, pages 388-390. Review of recent developments. Discusses new heat treating methods that have made it possible to use non-ferrous metals as substitutes for steel, new uses of Al and its alloys, development of "Everdur," a Cu-Si-Mn alloy of great strength, Ni alloys, "Konel," a Ni-Co alloy, Monel metal, babbitt, and a brazing alloy known as "Sil-Fos." RHP (11a)

Some Physical Properties of Commercial Thorium. J. G. Thompson. *Metals & Alloys,* Vol. 4, Aug. 1933, pages 114-118. Properties of commercially pure thorium obtained by Ca-reduction and electrolytically are described. 41 references.
WLC (11a)

On the Hardness of Metallic Elements. M. Tokunaga. *Kinzoku no Kenkyu,* Vol. 10, Sept. 1933, pages 393-408. Rockwell hardness as well as Shore hardness have been measured for 27 metallic elements. Conversion curves of hardness between Rockwell 1/8″ and 1/16″ steel balls, Rockwell diamond cone and 1/16″ steel ball, Shore diamond hammer and Rockwell 1/16″ ball, Shore steel hammer and Rockwell diamond cone and Shore diamond and Shore steel hammers are obtained. These curves differ from those of Cowdrey, Brumfield, Petrenko and Schwarz. The author has, also, found that there are parallel relations between atomic volumes, melting points, Shore hardness and atomic number of metallic elements. KT (11a)

Copper Alloy Wire. J. T. Kemp. *Wire & Wire Products,* Vol. 8, Oct. 1933, pages 310-317, 342. Development and principal uses of Cu alloy wires is outlined, physical properties and the influence on them by working processes described and tabulated and micrograms of structures reproduced. Alloys with Zn, Sn, Cd, Al, Si, Ni, Mn and Be are now in practical use. Cd alloys possess fair strength and good conductivity, Sn alloys are higher in strength and lower in conductivity, Zn alloys have a wide range of strength but too low conductivity for electrical uses. Be alloys can be hardened with heat treatment; they all have good ductility.
Ha (11a)

Production of Manganese Brass (Zur Herstellung von Manganmessing) E. T. Richards. *Die Metallbörse,* Vol. 22, Oct. 22, 1932, pages 1357-1358; Oct. 29, 1932, pages 1389-1390. In general, Mn-brass analyses fall within the following limits: 55-58 Cu, 37-40 Zn, 0.2-3.0 Mn, 0.5-2.5 Al, 0.2-1.5 Sn, 0.75-1.5 Fe and 0.2-1.0 Pb. A table is presented compiling the analyses of some 25 commercial Mn-brass alloys which exceed the limits specified above and which may also contain Ni, Sn and Pb in various amounts. Another table shows the analyses of 4 propeller alloys which contain 0.07-5.0 Ni and 0.1-2.2 Co respectively besides appreciable amounts of Mn. Tensile strength of Mn brass is about 45-65 kg./mm.^{2}, 15-20% elongation. The absence of the γ phase is stressed restricting Zn to 46-49% max. Zn usually runs lower and is replaced by other metals according to the following equivalency ratios: Al 6:1, Si 10:1, Sn 2:1, Pb 1:1, Fe .9:1 and Mn .5:1. The effect of Mn, Fe, Al, Pb and Sn upon the various properties of brass is dealt with in great detail. EF (11a)

Theory of Anomalous Magnetic and Thermoelectric Effects in Metals (Zur Theorie der anomalen magnetischen und thermoelektrischen effekte in Metallen) D. Blochinzev & L. Nordheim. *Zeitschrift für Physik,* Vol. 84, July 26, 1933, pages 168-194. Theory of thermoelectric and galvano-magnetic effects is developed and previous results enlarged and modified under more general assumptions of distribution and conditions of state of the electrons; irregularities in the Hall effect, Thomson effect, change of resistance in a magnetic field are explained with the new theory. Ha (11a)

Beryllium-Copper Castings : Foundry Practice, Heat-Treatment and Properties. Edwin F. Cone. *Metal Industry,* London, Vol. 43, July 28, 1933, pages 79-81; Aug. 4, 1933, pages 101-103. Physical and chemical properties of Be-Cu castings are discussed and curves given for electric and thermal conductivity, hardness values, mechanical properties and wear resistance; with respect to the latter, a Be bronze with a Rockwell hardness of B 85 lost 0.0084 g./10,000 revolutions while a steel specimen lost 0.0168 g.; after a 3 hr. precipitation hardening treatment a hardness of C 43.3 was obtained and only 0.0003 g. were lost as compared with 0.0001 g. for the standard steel. Be-Cu castings are now used for bearing sleeves in airplane propellers, cams, as corrosion resistant material, gears, etc. A much wider application of this alloy is foreseen, especially for Be-Cu-Ni alloys. Hap (11a)

The Coefficient of Friction of Bearing Metals for Bridge Seats. R. P. Davis & G. P. Broomsliter. *Report of Committee on Iron & Steel Structures, American Railway Engineering Association, Bulletin* 351, Nov. 1932, pages 300-308. The investigation was to determine the coefficient of friction between various combinations of bronzes and steel in use for expansion bearings in concrete girder bridges. The cast phosphor bronze plates of a material designated as B22-21 is composed of Cu plus not over 17% Sn, not over 1% P, not over 0.5% other elements; min. deformation limit is 18000 lbs./in.^{2}, permanent set in 1″ under 100000 lbs./in.^{2} between 0.1″ and 0.2″. The tests with various rolled and cast bronzes and cast steels showed that the friction coefficient is independent of the normal pressure; the coefficient is between 0.12 and 0.165 for pressures from 500 to 20000 lbs./in^2. Machined surfaces give as low coefficients as rolled planished surfaces; grinding the surface of rolled steel plates reduces the coefficient materially. Average coefficient of bronze on steel was 0.146, steel on steel 0.181. The coefficient of friction as determined by the use of inclined planes is materially higher than found by the pressure method. Hap (11a)

Progress in Processing Non-Ferrous Alloys. I. Improvement by Heat Treatment. II. Use of New Alloying Constituents and Removal of Impurities. (Fortschritte bei der Erzeugung von Legierungen der Nichteisenmetalle. I. Erweiterung und Anwendung der Vergütung durch Wärmebehandlung. II. Einführung neuer Legierungsbestandteile und Beseitigung von Verunreinigungen) H. Kalpers. *Technische Blätter der deutschen Bergwerkszeitung,* Vol. 23, Aug. 27, 1933, page 467; Sept. 3, 1933, pages 474-475. In Pt. I. the improvement of mechanical properties attainable by heat treating is considered for some special non-ferrous alloys. Among corrosion resistant alloys an Al-Cr alloy with up to 5% Sb and Cr not exceeding 6%, Al alloys with Mg and Ti and a process patented to the German Dye Trust for improving corrosion stability of Mg-Mn alloys are considered. Al alloys the mechanical properties of which can be improved by subsequent mechanical and thermal treatment can be further improved by small additions of certain elements as Zr, Ta, Tb, Nb, etc. The process for improving Cu alloys with Si, Ni and Co contents, patented to the Metallgesellschaft, Frankfort/Main, is remarkable. Such alloys are heated to 900°-950° C. quenched, artificially aged at 520°-530° C. and then slowly cooled. Investigations have shown that method of aging considerably affects the properties. By repeated heating and cooling to room temperature during the aging process, for instance, alloys with 88-98% Al attained tensile strengths from 36 -55 kg./mm.^{2} and elongations of 18-26%. Such excellent properties are not attained by other aging methods. The method is particularly adaptable to alloys of Al with Zn, Cu, Mg, Be. Among methods for improving by adding alloying constituents and removing impurities are: (1) the Pacz method for processing Cu alloys of high strength, plasticity, resistivity against heat and chemical reagents. Such Cu alloys with small additions of Al, Si and Fe are made by alloying these metals in powdered form. (2) New deoxidation method of Ni and Ni alloys. Li is used as deoxidizer. (3) Pb containing bearing metals containing about .6-65% Na, .75-1% Ca, .2-.25% Mg, .1% Al. (4) Methods of purifying Al alloys, as the Schmidt and Godefroid methods for removing oxides in Al melts and the method of the Vereinigte Aluminiumwerke for removing Ti from Al alloys. GN (11a)

Light Metal Piston Construction for Power Engines (Leichtmetallkolbenbau für Kraftmaschinen) E. Mahle. *Werft, Reederei und Hafen,* Vol. 14, Sept. 15, 1933, pages 255-256. Reviews the difficulties which had to be overcome during the evolution of light metal pistons. The latest perfections are partly based on structural features, which can be taken from 7 typical illustrations, and partly due to the adoption of Al-Si alloys. These have a coefficient of expansion which is 25% lower than that of the previously used Al-Cu alloys. WHp (11a)

Utilization of the Resistance of Materials by the Engineer (Exploitation par l'Ingénieur, de la Résistance des Matériaux) A. Caquot. *L'Usine,* Vol. 42, Oct. 26, 1933, pages 25-27. A paper before the Society of Civil Engineers (France) discusses the various properties of materials and methods for their determination, and the manner in which the engineer uses the materials according to their properties. Ha (11a)

Heat Content of Some Metals, Alloys and Slag-Formers at Temperatures up to 1200° C. (Warmeinhalt einiger Metalle, Legierungen und Schlackenbildner bei Temperaturen bis 1200° C.) H. Esser, R. Averdieck & W. Grass. *Archiv für Eisenhüttenwesen,* Vol. 6, Jan. 1933, pages 289-292. Results of very exact measurements with a metal block vacuum calorimeter are reproduced in curves for Cu, Pt, 3 nickel-silver alloys, 3 brass alloys, pure quartz, aluminum oxide, calcium oxide, manganous oxide, natural fayallite, magnetic iron oxide and natural magnetite. The average specific heats of these materials are calculated from the measured values. 27 references. Ha (11a)

The Effect of High Electrostatic Fields upon the Vaporization of Molybdenum. G. B. Estabrook. *University of Pittsburgh Bulletin,* Vol. 29, Jan. 10, 1933, pages 65-77. The W-wire in a filament lamp is known to decrease in operation in diameter by vaporization of the metal. If, however, a radial electrostatic field is applied, of a strength of 0.52×10^{-6} volts/cm. or more the rate of vaporization first decreased slowly, then more rapidly, and at field strengths of over 1.8×10^6 volts/cm. asymptotically approached zero. Increasing temperatures reduced the rate of decrease of vaporization for the same field strength. Sudden increase in resistance occurred when the field was applied, and a sudden decrease upon removal of the field. A similar behavior was found for Pt. A theoretical derivation for calculating the increase in resistance is given in an appendix. 6 references.
Ha (11a)

Experimental Contributions to the Knowledge of Magneto-Optic Rotation of Nickel (Ein experimenteller Beitrag zur Kenntnis der magneto-optischen Drehung des Nickels) K. H. v. Klitzing. *Zeitschrift für Physik,* Vol. 85, Sept. 4, 1933, pages 240-252. The Kerr-effect of Ni was determined in the ultra-red range and as a function of wave length, field strength and temperature. The rotation is generally proportional to the magnetization. Ha (11a)

Progress 1930-1932 in the Field of Free Alkali Metals (Fortschritte 1930-1932 auf dem Gebiete der freien Alkalimetalle) H. Alterthum & R. Rompe. *Angewandte Chemie,* Vol. 46, June 3, 1933, pages 303-311; Aug. 26, 1933, pages 545-551. A complete review of atomic properties, molecular and special states, properties of the solid metal and technical applications of K, Rb, Cs and Li. A list of references is given for each metal. Ha (11a)

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To clarify the meaning of "Carnegie Controlled Carbon-Steels," our customers should understand that it refers to processes of manufacture and should not be interpreted as applying to the chemical composition of the steels. The desirable characteristics and uniformity of these steels are fully and consistently developed through metallurgical control and constant supervision of every detail of manufacture.

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Ferrous (11b)

E. S. DAVENPORT, SECTION EDITOR

Further Nickel-Chromium Cast Irons. Alan E. W. Smith. *Iron & Steel Industry & British Foundryman,* Vol. 6, Feb. 1933, pages 171-177. Investigation of the effect of heat treatment on particular properties of cast irons with less than 1% Cr and Ni ranging in steps up to 12%, and alloys with 15, 20 and 25% Ni. Nickel provides pearlitic, martensitic and austenitic cast irons in the cast state, the first 2 of which can be modified by heat-treatment. The addition of Cr imparts stability and growth resistance to the irons. In the cast condition the improvements due to Ni and Cr were not outstanding, but they followed generally recognized trends. Upon annealing, Ni delays, but does not prevent the decomposition of pearlite; Cr appears to stabilize the carbides. This was shown by strength values after heating the irons for 24 hours at 650° C. Strength of Ni iron fell from 34,000-38,000 lbs./in.^{2} to less than 25,000 lbs./in.^{2}, whereas the introduction of 0.7% Cr maintained the strength of the Ni irons at 34,000-38,000 lbs./in.^{2}.
CHL (11b)

Alloys Which Harden at High Temperature (Alliages durcissant à température élevée) A. Portevin. E. Pretet & H. Jolivet. *Revue du Nickel,* Vol. 4, July 1933, pages 78-79. The limit of solubility of W in a 33% Ni austenite is as follows:

1400° C.	1300° C.	1200° C.	1100° C.	1000° C.	900° C.	800° C.
23%	17%	13%	12%	11%	9.5%	8.5%

This type of alloy, as aged, has excellent properties at high temperatures. Proportional limit values at 800° C. after an aging of 24 hours at 850° C. following casting, are given below:

	Composition		Proportional Limit
Alloy	% W	% Ni	(Compression) in kg./mm.^{2}
A	25	25	34
B	25	30	33.5
C	25	35	32.5
D	30	30	37
E	30	40	38

Hardness values for Alloy B are shown below (initial hardness 170 Brinell):

		Brinell Hardness After Treatment			
Temp. °C.	Time in Hours	2	4	6	8
650		188	197	200	200
800		233	260	275	280
875		269	300	306	310
1075	(maximum 310 after 30 min.)	281	287	208	285
1140	(maximum 272 after 20 min.)	265	261	255	250

For best properties the precipitated phase must be finely distributed as a Widmanstätten pattern.
AH (11b)

Notched-Bar Toughness after Aging of Open-Hearth Steel Melted from Scrap (Alterungskerbzähigkeit des aus Schrott erschmolzenen Siemens-Martin-Stahls) H. Wilhelm & L. Jahn. *Archiv für das Eisenhüttenwesen.* Vol. 7, Sept. 1933, pages 201-203. About 2000 notched bar impact tests were made on 24 open-hearth heats by low carbon steel melted from 100% scrap charges. The specimens were tested as normalized and also as aged, i.e., compressed 10% and then heated 1 hr. at 250° C.; tests were made over a range of temperatures from sub-zero to 250° C. The sharp drop in notched-bar impact resistance at low temperatures, in both normalized and aged specimens, did not differ from that given in published results for steel melted from various types of charge. It was concluded that melting procedure is of more importance in regard to "notched bar impact aging" than the type of charge.
SE (11b)

Influence of Nickel and Silicon on the Growth of Cast Iron (Einfluss von Nickel und Silizium auf das Wachsen von Gusseisen) O. Bornhofen & E. Piwowarsky. *Archiv für das Eisenhüttenwesen,* Vol. 7, Oct. 1933, pages 269-274; *Die Giesserei,* Vol. 20, Mar. 17, 1933, page 114. Length changes after various heat treatments were measured in cast iron specimens containing about 3.5% C: 0.25-5.8% Si; 0.03% Mn: 0.02% P: 0.015% S, and from 0-5.7% Ni. Si increased the growth in pearlitic irons and—to a lesser extent—in ferritic irons, but this effect of Si was reversed in malleableized irons. When Si was replaced by Ni so as to give the same amount of graphitization, growth was greatly reduced. In the absence of another graphitizing element, Ni increased the length changes on annealing somewhat; however, this did not occur in the presence of a certain residual Si content. The least growth occurred in iron containing 3.05% C; 0.23% Si; 1.95% Ni. In general, the least growth was shown by samples with fine "temper carbon" graphite; the most, by irons with a pearlitic matrix or with coarse graphite flakes; those with a ferrite matrix showed intermediate growth. Electric resistance measurements indicated oxidation of the Si to be the main cause of growth.
Ha + SE (11b)

Mechanical Properties of Electric Steel Castings (Festigkeitseigenschaften von Elektrostahlguss) E. Knipp. *Die Giesserei,* Vol. 20, May 12, 1933, pages 193-197; *Foundry Trade Journal,* Vol. 49, Aug. 31, 1933, page 120. Mechanical properties of a basic electric steel casting which was annealed for 4 hrs. at 920° C. and cooled slowly in the furnace, were determined at room and elevated temperatures. If a casting is to be used at high temperatures, hardening or refining does not give any advantage as these effects are lost in time. Quenching shifts the zone of blue-brittleness to lower temperatures, the more so the greater the quenching velocity. Duration of annealing has an appreciable influence only up to 10 hrs.; the maximum notch-toughness at room temperature is reached after 1 hr. At 500° C. tensile strength increases and elongation decreases with increasing C content, just as at room temperature; tensile strength at these temperatures increases with increasing Mn-content, while elongation at room temperature is little influenced by Mn up to 1% and is reduced considerably with higher contents.
OWE + Ha (11b)

Martensitic Quenching of Cast Iron. With Special Reference to Low-Carbon Irons with High Manganese Contents. Georges R. Delbart. *Transactions American Foundrymen's Association,* Vol. 41, 1933, pages 20-50. The presence of more than 2% Mn in cast Fe favors martensite formation to the extent that pieces up to 1" in thickness become martensitic on air cooling. Low C, high Mn irons show increased structural stability when subjected to elevated temperatures. C contents of 2.50 and 2.80% for cupola and electric furnace irons respectively are recommended. Up to 2%, Mn has only a slight effect on primary hardening; above this percentage its action is more marked but can be neutralized with Si. Mn reduces the deflection in the transverse test.
CHL (11b)

Sensitivity of Iron Castings with Variable Wall Thickness (Die Wandstärken-Empfindlichkeit von Grauguss) R. Berger. *Zeitschrift für die gesamte Giessereipraxis,* Vol. 54, Sept. 17, 1933, pages 381-382. Cracks in castings are frequently due to variable shrinkage of sections possessing different wall thickness; carbide and graphite contents also vary with thickness of section. Whereas in unalloyed Fe castings rapid cooling of thin sections and slower cooling of thicker sections brings about stresses leading to cracks, this drawback can be eliminated by adding Mo. Tests are described showing that amount of combined C and Brinell hardness were rather uniform in a certain type casting with wall thickness varying between 10 and 40 mm. A similar favorable result was obtained upon casting a wheel with wall thickness of rim changing from 20-60 mm. 3 types of cast Fe were used. Tables show composition, hardness and C contents in different sections of these cast wheels.
GN (11b)

The Question of Temper Brittleness (Zur Frage der Anlasssprödigkeit) M. H. Kraemer. *Zeitschrift Verein deutscher Ingenieure,* Vol. 77, Sept. 2, 1933, page 945. Temper brittleness is defined as the deterioration of notch-toughness occurring after hardening and tempering of steels when cooled slowly from tempering temperature. The drop in notch-toughness may amount to 50%. No connection between this phenomenon and other mechanical or physical properties could be detected. It is assumed that an allotropic modification of Fe takes place. Experiments point to a precipitation, the nature of which has not yet been determined.
Ha (11b)

Co-action of Thermal Stresses and Transformation Stresses in Quenched Steels (Zusammenwirken von Wärme- und Umwandlungspannungen in abgeschreckten Stählen) H. Buehler & Erich Scheil. *Archiv für Eisenhüttenwesen,* Vol. 6, Jan. 1933, pages 283-288. Stresses in quenched steels must be attributed to 2 causes: first, the general shrinkage in cooling results in compression stresses on the outer parts and in tensile stresses in the core; secondly, the expansion due to the transformation from austenite to martensite results in a reverse distribution of stresses. The superposition of these 2 phenomena was measured on low C steels with 0-27% Ni and is illustrated in diagrams showing the forces acting in different layers. It was found that the common action of both stresses depends greatly on the temperature at which the transformation begins, whether or not the transformation has been completed when room temperature is reached and whether it takes place before or after reversal of the heat stresses. Both actions may counterbalance, thus causing a state free of any stresses. 13 references.
Ha (11b)

Iron-nickel alloys (Beitrag zur Kenntnis der Eisen-Nickellegierungen) O. Dahl & J. Pfaffenberger. *Zeitschrift für Metallkunde,* Vol. 25, Oct. 1933, pages 241-245. Permalloy and related alloys develop high permeability when quenched from above 600° C., but low permeability when reheated to lower temperatures, or slowly cooled; these changes can be conveniently followed by changes in electrical resistance. This behavior may be explained by (1) precipitation of impurities from solid solution in the vicinity of 500° C.; (2) redistribution of the Fe and Ni atoms from a random distribution at high temperature to a regular distribution at lower temperature; (3) — (2) inducing (1). Widely varying O-contents were found not to influence the effect, though widely varying C-contents changed the effect in degree. The effect was markedly present in an essentially C-free sample. Data are given for electrical conductivity, coercive force, permeability, and hardness for a series of alloys: 75% Ni, 25% Fe, with additions of Si up to 5%; 73% Ni, 27% Fe; 73% Ni, 27% Fe with addition of 5% Si; 60% Ni, 40% Fe, with addition of 15% Cu; these properties are given for alloys first annealed at 900° or 1000° C. for 1 hour, air cooled (or quenched), and reheated to increasing temperatures for 1-hour periods. 2% Si eliminates the decrease in resistance at 500° C., but more than this causes a resistance increase at the same temperature, suggesting that Si initiates a process opposite in effect to that occurring in Si-free alloys. Although the evidence seems in favor of a precipitation or phase change, occasionally no change in hardness obtains (alloy with 15% Cu). Followed by discussion.
RFM (11b)

The Properties of Pig Irons. J. E. Hurst. *Foundry Trade Journal,* Vol. 49, July 27, 1933, pages 53-55. Points out that the pig-breaking test frequently applied to iron to determine its characteristics is distinctly rough and ready. Presents evidence of the value of the method already described by author for determining stiffness of pig-iron, which he believes to be closely related to results of pig-breaking tests. Suggests that the included area of the stress-strain curve (resilience value) of the pig-iron concerned is essentially a close measure of the experience undergone in the ordinary breaking of materials with a hammer. Points out that it is legitimate to conclude that the strength characteristics of pig irons may vary in a way not to be predicted from their chemical composition, and that these variations are not eliminated by remelting. Causes of variation in properties of pig irons are dealt with briefly, and the influence of type of steel scrap on the characteristics of cast iron is discussed. Closes with a description of tests on roll irons, showing that a knowledge of the strength characteristics of iron can be successfully applied to the duplication of some of the inherent mechanical properties.
OWE (11b)

Anomalies in the "Temper" of Cast Iron; Their Relation to Oxidation (Anomalies de Trempe des Fonte; leur Rapport avec l'Oxidation) A. le Thomas. *L'Usine,* Vol. 42, Aug. 10, 1933, pages 24-25. The influence of O and other elements on the "temper" (hardness) of cast iron was investigated. Cast iron of a given composition has a definite "temper" which depends on the conditions of melting and the state of oxidation or deoxidation of the bath; the temperature of melting and pouring has no noticeable influence up to 1400° C. The anomaly of temper is hereditary, at least under usual conditions of melting without deoxidation. The anomaly remains within moderate limits in cast iron made in the cupola furnace, about 2-4 mm., but can easily reach 20 mm. in case of high rate of oxidation. Small additions of other elements (1%) can cause an appreciable change in the properties of cast iron simply due to disappearance of anomalous temper. Additions of more than 1% produce special cast irons. The long melting time in open-hearth furnaces favors oxidation and the anomalies of temper can assume high values and thus entirely change the characteristic properties of an alloyed cast iron. Examples and analyses of cast irons with different degrees of oxidation are given. Ha (11b)

Permanent Magnets of Precipitation Hardening Alloys (Dauermagnetwerkstoffe auf der Grundlage der Ausscheidungshärtung) W. Köster. *Stahl und Eisen,* Vol. 53, Aug. 17, 1933, pages 849-856. The constitution, magnetic properties, and heat-treatment of 2 groups of carbonless, dispersion hardening alloys of iron with elements forming a closed γ loop are described. First group consists of alloys of Fe with W, Mo, and Co; second group of alloys of Fe with Ni and Al. First group is forgeable and machineable; second must be used in the as cast state and must be ground. After quenching and precipitation hardening at about 700° C., the alloys have extremely good properties for permanent magnets, considerably better even than the ordinary Co magnet steels. First group has a coercive force of 60 to 350 Oersteds with high remanence and the second group has the unusually high coercive force of 600 Oersteds. The alloys are not subject to cracking, decarburization, and other difficulties attending the heat treatment of ordinary magnet steels, but since they lie within the α-phase region they may become rather coarse grained.
SE (11b)

Influence of a Second Alloying Metal on the Properties of Copper-Alloy Steel with Special Reference to Red-Shortness (Ueber den Einfluss eines zweiten Legierungsmetalls auf die Eigenschaften kupferlegierten Stahles unter besonderer Berücksichtigung der Rotbrüchigkeit) W. Raedeker. *Mitteilungen aus dem Forschungsinstitut der Vereinigte Stahlwerke Dortmund,* Vol. 3, July 1933, pages 173-198. Investigation of the influence of Ni, Cr, Mo, V, Co and Ti additions on the improvement in tensile strength of C steel caused by addition of Cu in small amounts. About 1% Cu increases tensile strength by about 7-8 kg./mm.^{2}; this is slightly reduced by addition of Ni, Cr, Mo and V. The greatest difference in strength between temper-hardened and soft-annealed Cu steel is about 14 kg./mm.^{2}; with the other alloy additions it is 14.7 kg./mm.^{2}. Notch-toughness is increased in all steels. A tempering temperature of 500° C. for 1½ hr. gives maximum hardness in both pure and alloyed Cu steels; cold-deformation shifts the maximum hardness to lower temperatures. The additional metals do not influence segregation velocity of Cu. Red-shortness occurs in Cu steels only above the m. p. of Cu, and requires the presence of molten Cu on the surface of the oxidizing steel; red-shortness is also influenced by O diffusing into the steel. Ni eliminates red-shortness in Cu steels; it forms solid solutions of high melting point with the segregated Cu; it also protects the steel against too rapid penetration of O. Cu steels alloyed with Mo, Co, V and 0.9% Ti incline to red-shortness; 1.3% Ti, however, eliminates the brittleness. Numerous charts and micrographs are given. 27 references.
Ha (11b)

Rapid-Machining Steel of Standardised Quality. *Mechanical World & Engineering Record,* Vol. 93, July 21, 1933, pages 701-703. **Phoenix Rapid-Machining Steel. Its Production and Characteristics.** *Machinery,* London, Vol. 42, Aug. 10, 1933, pages 551-555. Account of the manufacture of "Phoenix" rapid-machining steel. The new steel has physical properties comparable with those of mild steel and can be machined at unusually high speeds. A fine silky finish is obtained, and the rate of tool wear is low. The impact strength—30-35 ft.-lb. in the bright-drawn condition, 70-80 ft.-lb. in the black condition—is much higher than that of ordinary free-cutting steels. "Phoenix" steel may be used to advantage for drop-forgings and can be fire welded with good results; drawn into wire, its machining qualities are not impaired. Physical properties of "Phoenix" steel and mild steels are compared and presented in tables. Analysis is given as follows: 0.10% C max.; 0.20-0.25% S; 0.04-0.07% P; 0.80-1.0% Mn; 0.0% Si. Kz (11b)

Some Properties of Cold-worked Sorbitic and Austenitic Alloy Steel Wire. S. H. Rees. *Iron & Steel Institute, Advance Copy* No. 12, Sept. 1933, 14 pages. A Cr-Mo steel containing 0.34% C, 1.1% Cr, and 0.27% Mo and an austenitic steel containing 0.15% C, 16.1% Cr, 9.9% Ni, and 1.0% W were used. The Cr-Mo steel was sorbitized by patenting and then cold-drawn various amounts. Tensile properties both after drawing and after reheating to low and intermediate temperatures were determined. In the Cr-Mo steel the proportional limit reached a maximum when the cold-drawn material was heated to 250° C. Wires were stressed and heated for 2 hours at temperatures as high as 600° C. The minimum loss in stress occurred in the Cr-Mo wires that had been heated to 400° C. prior to stressing and in the austenitic wires that had been heated to 500° C. prior to stressing. On reheating the cold-worked austenitic wires both strength and ductility increased slightly, reaching maxima at approximately 400° C. Magnetic and density tests were made on the cold-drawn and reheated austenitic wires. Cold-working and reheating produced susceptibility to intergranular corrosion in the austenitic wires as determined by the acid $CuSO_4$ test. 3 references. JLG (11b)

Company Classifies Steel Castings. Frank G. Steinebach. *Foundry,* Vol. 61, Apr. 1933, pages 14-15, 43. Concluding article describing the practices of Detroit Steel Casting Co. Steel castings produced by the company are classified as follows:

Classification	Maximum Strength lbs./in.^{2}	Yield Point lbs./in.^{2}	Elongation in 2 in. %	Reduction in Area %	Brinell Hardness
D-1	55,000- 65,000	30,000- 35,000	30-40	40-60	125-135
D-2	65,000- 75,000	35,000- 45,000	25-35	35-50	135-145
D-3	75,000- 85,000	45,000- 50,000	18-25	30-40	160-180
D-4	80,000- 90,000	50,000- 60,000	20-30	35-50	150-170
E-1	80,000- 90,000	50,000- 60,000	20-30	35-55	150-180
E-2	85,000- 95,000	55,000- 65,000	20-30	35-50	170-190
S-1	95,000-110,000	60,000- 80,000	15-20	25-40	*179-228
C-1	90,000-120,000	70,000- 85,000	12-20	20-30	*165-210
C-2	120,000-150,000	90,000-120,000	7-12.5	15-25	†280-420
O-1	100,000-120,000	65,000- 75,000	12-20	20-30	180-200
O-2	85,000-100,000	60,000- 70,000	15-25	25-40	160-190

*Depending on tensile requirements.
†As desired to suit intended purpose. VSP (11b)

Some Principles Upon Which Depend Resistance and Solidity of Cast Iron (Quelques Principes dont dependent la Résistance et la "Solidite dans la Fonte) W. West. *Bulletin de l'Association Techniques de Fonderie,* Vol. 7, Dec. 1933, pages 514-527. The properties of fine-grained cast iron with particular reference to P content were investigated. Results were obtained on a large ingot, an ordinary cored casting and another plain casting of average dimensions. P content must be below 0.3% if good, dense, resistant castings are to be obtained. Consideration of the C-Si equilibrium alone does not suffice for obtaining castings of desired quality; P content also must be considered. The greater the P content the more exactly controlled must be the C-Si equilibrium because of the very narrow range within which these 2 elements may vary without encountering hardness in thin sections and porosity in heavy sections. Reduction of P to less than 0.3% permits a great variation in Si content, up to 0.5%, without producing hardness or porosity. The influence of P is accentuated by C contents higher than 3%. The narrower the solidification interval, the greater is the internal solidity, and regardless of C content, it is necessary to find a proper balance between P and Si. Ha (11b)

Relations between the Mechanical Properties and the Structure of Cast Iron (Relations entre les Propriétés Mécaniques et la Structure de la Fonte) Gustav Meyersberg. *Bulletin de l'Association Technique de Fonderie,* Vol. 7, Sept. 1933, pages 338-351. Cast iron considered as steel containing graphite particles which have the effect of holes and notches in the metal. The graphite tends to concentrate and divert forces acting through the cast iron. Bending tests are preferable to tension tests when the elongation of the material is low and must be measured accurately. Cast iron is less sensitive to notch effects from exterior blemishes than steel. C in cast iron gives pourability and decreases shrinkage, as well as imparting resistance to abrasion. WHS (11b)

Heat of Mixture of Liquid Fe-Ni-C Alloys (Ueber die Mischungswärme von flüssigen Fe-Ni-C Legierungen) F. Sauerwald & F. Fleischer. *Zeitschrift für Elektrochemie,* Vol. 39, Aug. 1933, pages 686-687. The increase in temperature observed when liquid Fe and Ni are mixed in the presence of C leads to the conclusion that the heat evolution is mainly due to the combining of Fe and Ni. Values found were in agreement with the heats of formation as given by Kawakami. Ha (11b)

Experiments on Cast Irons of High Resistance and Low Carbon Content (Esperienze sulla Ghisa di alta Resistenza a basso Carbonio) V. Palchetti. *L'Industria Meccanica,* Vol. 13, Nov. 1933, pages 869-873. The best way to produce cast iron of high resistance (high tensile strength, resistant to corrosion and high temperature, etc.) consists in mixing 80-85% steel with an Fe alloy recarburized in the cupola furnace. Different charges for various purposes are given and properties of the respective castings described. Ha (11b)

Quasi-Isotropy in Cast Iron (Quasiisotropie im Gusseisen) Hans Pinsl. *Die Giesserei,* Vol. 20, Mar. 17, 1933, pages 105-108. Influence of diameter of sample of a homogeneous cast iron was investigated by the methods of Oberhoffer and Poensgen for diameters from 5 to 30 mm. Both methods showed constancy of the specific bending and tensile strengths (quasi-isotropy) from a diameter of 20 mm. upwards; from 20 to 5 mm. diameter both bending and tensile strength decreased 30%. Compressive strength decreases with increasing diameter and remains constant above 25 mm. Pendulum impact strength and deflection increase with diameter; constancy of these values could not be observed with certainty. Ha (11b)

A Few Properties of Alloyed Cast Iron (Einige Eigenschaften von legiertem Gusseisen) C. Pfannenschmidt. *Die Giesserei,* Vol. 20, Oct. 27, 1933, pages 473-481. The literature on the influence of alloying additions to cast Fe is reviewed and curves and tables of mechanical properties are reproduced. Alloyed cast Fe's show considerable improvement of the ratio/bending vibration strength: tensile strength which, for unalloyed cast Fe, is 0.33-0.45, but for alloyed cast Fe is 0.5-0.6. This means that alloyed cast Fe may be used in many cases where steel castings or welded members often are employed. This does not take into account the improvement in resistance to corrosion and wear which also is appreciable. 41 references. Ha (11b)

Alloyed Gray Cast Iron. Carl W. Pfannenschmidt. *Foundry Trade Journal,* Vol. 49, Aug. 3, 1933, pages 61-63; Aug. 10, 1933, pages 81-83; Sept. 7, 1933, pages 132-133. Discusses Roll's classification of the alloy elements, based upon their effect on the combined C content of cast iron, and deals with the influence of Cr, Cr + Ni, Ni, Ni + elements other than Cr, V, and Cu upon the properties. Attention is directed to the effect of these elements upon heat-resisting and corrosion-resisting properties of cast iron. Includes 20 diagrams illustrating graphically most of the points. OWE (11b)

Elasticity of Cast Iron under Compression. *Locomotive,* Vol. 39, Apr. 1933, pages 174-175. Cast iron was found to possess appreciable elasticity. A shaft which fitted very nicely into a cast iron spider when the shrink rings were in place dropped out when the shrink rings were taken off for a repair. Ha (11b)

Cast Nickel Steel (Nickellegierter Stahlguss) *Zeitschrift für die gesamte Giessereipraxis,* Vol. 54, Oct. 29, 1933, pages 444-447. Paper considers chemical composition, heat treatment, properties and applications of the most widely used types of cast Ni steel. These steels are distinguished by excellent toughness, high resistance to fatigue and aging and offer no difficulties in machining when properly heat treated. Cast steels with 1%, 2%, 3% and 5% Ni are discussed. 8 references. GN (11b)

Cast Chromium-Nickel Steel (Chrom-Nickelstahlguss) M. Waehlert & E. Pohl. *Zeitschrift für die gesamte Giessereipraxis,* Vol. 54, Nov. 12, 1933, pages 465-467. Paper considers chemical composition, heat treatments, tensile properties, hardness, notch toughness, etc., and applications of cast Cr-Ni steel. The valuable properties of cast Ni steel such as toughness and high resistance to fatigue are supplemented in cast Cr-Ni steel by high hardness and tensile strength. GN (11b)

Cast Nickel Steel for Special Applications (Nickellegierter Stahlguss für besondere Spezialfälle) M. Waehlert & E. Pohl. *Zeitschrift für die gesamte Giessereipraxis,* Vol. 54, Nov. 26, 1933, pages 487-489. Paper discusses chemical composition, heat treatment, mechanical and other properties and applications of a few special types of cast Ni steel. Non-magnetic cast steel with 25-28% Ni and various types of heat and corrosion resistant cast Ni-Cr steels of the martensitic and austenitic varieties are discussed. GN (11b)

Cast Nickel Steel with Special Alloying Additions (Nickellegierter Stahlguss mit besonderen Legierungszusätzen) M. Waehlert & E. Pohl. *Zeitschrift für die gesamte Giessereipraxis,* Vol. 54, Nov. 12, 1933, pages 467-468. Chemical composition, heat treatment, tensile properties, notch toughness and applications of cast Mo-Cr-Ni and V-Ni steels are considered. GN (11b)

Impact Properties of Austenitic Chromium-Nickel Steels. Roy W. Tindula. Master's Thesis, Carnegie Institute of Technology, Pittsburgh, 1932, 58 pages. Square bar specimens were forged, homogenized, and the carbides precipitated by heat treatment before being tested for Charpy impact strength. The broken pieces were polished and examined microscopically for carbide distribution. Impact properties depend on the relative amount of carbide precipitation. Corrosion loss is due to excessive Cr depletion in regions of greatest carbide formation. CWS (11b)

Hardness of Chilled Iron Rolls (Ueber den Härtegrad von Hartgusswalzen) Scharffenberg. *Die Giesserei,* Vol. 20, Aug. 18, 1933, pages 346-352. The difference between depth of hardness and intensity of hardness is pointed out; the latter is not the same in all parts of the roll. C, the sum C+ Mn, P, S and Cr increase hardness; Si does not increase or decrease hardness. Intensity of hardness is influenced by wall thickness, temperature and degree of wear of the chill molds. Photomicrographs show that fineness of grain of the solid solution increases with hardness. Ha (11b)

Notes on the Density of Iron-Nitrogen Alloys (Bemerkung über dichten der Eisen-Stickstoff-Legierungen) A. Sieverts & H. Hagen. *Zeitschrift für Elektrochemie,* Vol. 39, Sept. 1933, pages 735-736. Calculation of the density of Fe-N alloys from the lattice constants and constitutional diagram of this system is explained. Results agree with X-ray determinations. Density of Fe_2N is found to be 6.88. Ha (11b)

Aging in Boiler Steels. *Railway Engineer,* Oct. 1933, page 290. A spontaneous change in steel occurring below 700° C., whereby either or both of 2 constituents may be precipitated in sub-microscopic form is cited as the cause of aging trouble. The precipitates (carbides or nitrides) are rejected at the planes of shear stress within the grains and hinder the response to further deformation. The effect is more marked in cheaper commercial steels containing undue percentages of injurious metalloids or which have been incompletely deoxidized. Alloy steels, particularly those containing 2-5% Ni, are notably resistant to aging embrittlement. The resistance of Ni steel to corrosion and corrosion fatigue is in its favor; its higher tensile strength makes it appreciably more resistant to deformation under excessive riveting pressure and tends to restrict rash drifting and caulking. WH (11b)

Effect of Zirconium in White Iron Mixtures. F. B. Riggan & H. C. Aufderhaar. *Iron Age,* Vol. 131, Mar. 16, 1933, pages 426-427. Experimental data on the effect of additions of Zr to gray Fe. Zr has a softening effect on Fe and also acts as a deoxidizer. Softening begins on addition of 0.2% Zr, and 0.4 to 0.5% Zr gives the best results. Tensile strength and elongation are increased. Author believes Zr treated Fe is more easily machined and results in longer tool life. VSP (11b)

Strength of Welded and Cast Parts (Die Festigkeit von geschweissten und gegossenen Teilen) A. Thum. *Die Giesserei,* Vol. 20, Sept. 8, 1933, pages 391-392. Cast parts subjected to alternating stresses are as good as parts welded with filler weld; for complicated shapes casting is superior. Castings of good quality with thin walls always show excellent values in fatigue and are as cheap as welded parts. By properly shaping a piece its endurance strength can be greatly increased. Ha (11b)

Relations between Wall Thickness, Diameter of Rod and Maurer's Diagram for Cast Iron (Beziegungen zwischen der Wandstärke, dem Stabduchmesser und dem Maurer-Diagramm für Gusseisen) M. v. Schwarz & A. Vaeth. *Die Giesserei,* Vol. 20, Sept. 1, 1933, pages 373-376. The relations between the strength of a round rod specimen and that of a cast wall thickness are given in a formula and checked by test. Up to a wall thickness of 30 mm. the structure and tensile properties of a wall r mm. thick correspond to those of a round specimen of 2r mm. diameter. The pearlitic range of the Maurer diagram is extended to the right for C contents of more than 2.8% and the relation between Si and C contents explained. The Maurer diagram is then developed for commercial castings rich in P, with 1.1 to 1.4% P. Higher P content retards the formation of metastable cast iron. Micrographs and diagrams illustrate the relations. 15 references. Ha (11b)

Volume Change in Iron Alloys in the Melting Range (Ueber die Volumenänderung von Eisenlegierungen im Schmelzbereich) F. Sauerwald & F. Fleischer. *Archiv für das Eisenhüttenwesen,* Vol. 7, Oct. 1933, pages 219-221. Length changes in the melting range in various iron alloys were studied by means of a special dilatometer in which the sample could be heated in vacuo. In white cast iron and steel, the enrichment of austenite in C during solidification was accompanied by an expansion; the reverse effect occurs during the impoverishment of austenite in C on melting. In graphitic cast iron, the absorption of graphite by austenite and by the melt on heating, resulted in a contraction, with the reverse effect on cooling. In ordinary cast iron three different effects overlap, and in addition there is the large volume change resulting from the escape of dissolved and reacting gases. SE (11b)

Study of the Process of Decomposition of Heat Resisting Steel with Various Additions. Charles E. Williams. Master's Thesis. Carnegie Institute of Technology, Pittsburgh, 1932, 39 pages. 21 Cr-Ni steels containing special additions of Mn, Si, Cu, V, W, Ti, Mo and Te were studied. Decomposed and undecomposed samples were tested for impact, hardness, magnetic properties and corrosion resistance in Strauss solution. Curves are given showing effect of quenching temperature on impact values and amount of magnetic phase. CWS (11b)

Speaking of Steel for Helical Springs

WHEN a mountainous wave crashes against the rudder of a ship the steering gear might be badly damaged except for the great, heavy helical springs that absorb the shock. Incidentally, there's *one* kind of helical spring for which Bethlehem makes the steel.

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BETHLEHEM *Fine* ALLOY STEELS

Effect of Heat Treatment on the Physical Properties of Stainless Steel. G. A. Holderness & W. C. France. *Masters' Thesis, Carnegie Institute of Technology,* Pittsburgh, 16 pages, 1932. Study of the relationship between tempering temperature, hardness and impact strength of steels containing from 12-17% Cr, with and without Ni, Cu, and Mo in amounts of less than 1%. There exists in stainless steels a brittle range at about 950° F. Tempering quenched steels at this temperature produces a marked decrease in impact resistance. Within the brittle range, Ni has a very deleterious effect on the impact value and increases the temperature limits of the brittle range. 400°-600° F. is the best tempering range when Ni is present in small amounts. 1% Cu lowers impact resistance but maintains the hardness up to 1000° F. Mo, in small amounts, has no appreciable effect. 14 references. CWSp (11b)

Chromium and Chrome-Nickel Iron Alloys. T. Holland Nelson. *Product Engineering,* Vol. 4, July 1933, pages 258-260; Aug. 1933, pages 292-296; Oct. 1933, pages 340-341. Alloys of Fe with Cr and Ni are discussed in 4 groups: 1. Fe with varying percentages of Cr; 2. Fe with varying percentages of Ni; 3. Fe with varying percentages of Cr and Ni with Ni in smaller amounts than Cr; 4. Fe with varying percentages of Cr and Ni with Ni in larger amounts than Cr. Physical properties at various temperatures up to 1400° F., corrosion resistance and heat-treatment for each type of alloy are described. A table showing the classification, characteristics, properties, available forms and fields of application of commercial Fe-Cr-Ni is given. Ha (11b)

Some Experiments on the Resistance to Wear of Nitrogen-hardened Cast Iron. J. E. Hurst. *Iron & Steel Institute,* Advance Copy No. 8, Sept. 1933, 13 pages; *Foundry Trade Journal,* Vol. 49, Sept. 21, 1933, pages 163-165; *Iron & Coal Trades Review,* Vol. 127, Sept. 22, 1933, pages 444-445. Wear was measured by enlargement of bore of cylinder liners in automobile engines. Tests on an engine geared to a generator and on one in a car showed that nitrided cast iron had greater resistance to wear than other cast irons. The rate of enlargement of the bore was approximately twice as great in an unalloyed cast iron. Heat-treated Cr and Cr-Ni cast irons were also tested; the rate of wear for these irons was almost the same as for unalloyed iron. JLG (11b)

Design Factors for Malleable Iron. J. H. Lansing. *Foundry,* Vol. 61, Jan. 1933, pages 24-25, 37. See "Malleable Iron Castings, Their Design and Physical Properties," *Metals & Alloys,* Vol. 4, Apr. 1933, page MA 100. VSP (11b)

Relations Between Properties of Structure and Different Qualities of Cast-Iron (Les Relations entre les Propriétés de la Structure et les differentes Qualités de la Fonte) G. D'Ardigny. *Revue de Fonderie Moderne,* Vol. 27, Mar. 10, 1933, pages 65-71. Recent investigations of Meyersberg, Ober, Hoffer and Portevin are discussed. Although, in general, graphite is to be considered as a harmful constituent, it imparts qualities to cast Fe which make it preferable to steel for some applications, especially if the application involves questions of good castability, sliding friction and damping of vibration. These qualities can now be obtained in cast iron which has almost the same tensile strength as steel. Ha (11b)

Mechanical Properties of Alloyed Cast Iron and a New Method for Evaluation of Bending Tests (Über die mechanischen Eigenschaften legierten Gusseisens und ein neues Verfahren zur Auswertung von Biegeversuchen) H. Jungbluth & A. Pomp. *Die Giesserei,* Vol. 20, Sept. 15, 1933, pages 419-420. See *Metals & Alloys,* Vol. 4, Oct. 1933, page MA 310. Ha (11b)

Martensitic Cast Iron (Martensitisches Gusseisen) R. Hanel. *Maschinenbau,* Vol. 12, Feb. 2, 1933, page 81. See *Metals & Alloys,* Vol. 4, July 1933, page MA 206. RV (11b)

Effect of Chromium on Cast Iron. Charles O. Burgess. *Foundry,* Vol. 61, June 1933, pages 43, 82, 84. See *Metals & Alloys,* Vol. 4, June 1933, page MA 195. VSP (11b)

Modern Trend in Cast Iron. R. P. Bethell. *Proceedings Staffordshire Iron & Steel Institute,* Vol. 47, Session 1931-32, pages 2-9. This presidential address deals with past and current investigations on the subject of improvement in the quality and characteristics of pig iron. Chemical and physical properties required of good quality pig iron are discussed. It is the general belief that irons have some inherent or intrinsic properties which are not revealed by the ordinary tensile and transverse tests. It is recommended that careful chemical and physical grading be employed for all the raw materials entering the furnace. GTM (11b)

Effect of the State of Surface on the Strength of Materials (Der Einfluss der Oberflächenbeschaffenheit auf die Festigkeit der Baustoffe) Füchsel. *Organ für die Fortschritte des Eisenbahnwesens,* Vol. 88, Sept. 1, 1933, page 240. Calls attention to the publications of Lea, Thum and Buchmann revealing the marked effect of surface inhomogeneities, grooves, corrosion attack and cold stretching on the strength of material. The fatigue strength as determined on smooth test bars may be reduced by 30-70% due to rough surfaces. Nickel plating also lowers the endurance limit of steel. EF (11b)

Significance of the Detrimental Influence of Phosphorus on Steel (De Beteekenis van den schadelijken Infloed van Phosphor op Staal) W. Beckers. *De Ingenieur,* Vol. 48, Aug. 4, 1933, pages W.144-W.147. According to tests, in which the effect of O and all other influences which could adversely affect the quality of steel were eliminated as far as possible, the detrimental effect of P was found to be greatly exaggerated. A content of 0.06% P is permissible; harmful effects must be attributed to other impurities. 7 references. Ha (11b)

The Influence of Molybdenum, Tungsten and Titanium on Cast Iron. J. E. Hurst. *Iron & Steel Industry & British Foundryman,* Vol. 6, Mar. 1933, pages 205-208; May, 1933, pages 269-273; June, 1933, pages 315-316. Extended review of recent investigations on the Mo, W and Ti bearing cast irons. Results of individual investigations and other data are summarized in many charts and tables. CHL (11b)

Copper-Bearing Steel Rails for Mine Use. J. O. Greenan. *Engineering & Mining Journal,* Vol. 134, Sept. 1933, page 364. Comparative tests of a steel containing .25% Cu and a plain C steel show the former 10 times as resistant to the corrosive action of an 0.8% H_2SO_4 solution. The Cu-bearing steel costs only 10% more than plain C steel. WHB (11b)

Gray Iron for Mechanical Engineering (Grauguss für den Maschinenbau) R. Mailänder & H. Jungbluth. *Technische Mitteilungen Krupp,* Sept. 1933, pages 83-91. Modern gray and alloyed cast irons and their characteristics are discussed, their properties represented in curves and methods for testing and standardization with regard to practical applications illustrated by isoflex curves. Ha (11b)

Tensile Properties of 25% Chromium—20% Nickel Rod. J. L. Everhart. *Wire & Wire Products,* Vol. 8, Nov. 1933, pages 363-365, 380. An alloy of the following composition: 0.20% max. C; 2.00% max. Si; 0.7% max. Mn; 0.03% max. S + P; 23-27% Cr; 17-21% Ni; recently introduced for service where greater resistance to scaling is required than is possessed by the usual 18-8 alloy. It can be cast and rolled but is not as easily worked as 18-8. It stands up very well at temperatures up to 1200° F. It has a Rockwell hardness of about B-90; yield point of 40,000 and tensile strength of 85,000 lbs./in.^{2} which drops to about 25,000 at 1500° F. With an addition of 3.33% W, yield point was 57,000, tensile strength 93,000 decreasing to 50,000 at 1250° F. The change in ductility, which is low at elevated temperatures, was the same both with and without W addition so that caution must be used in applications where the possibility of shock or considerable vibration exists. Ha (11b)

New Heat and Corrosion Resistant Steel (Neue wärme- und korrosionsbeständige Stahllegierung) *Technische Blätter der deutschen Bergwerkszeitung,* Vol. 23, Sept. 17, 1933, page 504. Correction on paper by Kalpers in *Technische Blätter der deutschen Bergwerkszeitung,* Vol. 23, Aug. 6, 1933, page 426. It is pointed out that the use of Ta in Cr steels for attaining high temperature stability was first patented by the Röchling-Buderus Steel Works and not by the Böhler works. The Röchling patent covers steels with 20-60% Cr, 1-12% Co, .5-18% Ta, C below 1%, balance Fe. These steels are practically free from scaling up to 1200° C., rust proof and more resistant to HCl and H_2SO_4 than pure Cr steels with same Cr content. These steels are marketed under trade name "Furodit." GN (11b)

Tensile Properties of Specimens from an Electrically Welded Drum (Festigkeitseigenschaften von Proben aus einer elektrisch geschweissten Trommel) E. Rueter. *Zeitschrift Verein deutscher Ingenieure,* Vol. 77, Aug. 26, 1933, pages 917-920. Tests of specimens taken from an electrically welded drum of a steel of 35-44 kg./mm.^{2} tensile strength showed that tensile, bending, notch-impact strength and other properties were the same in the weld as elsewhere in the material. Ha (11b)

Silicon Cast Iron (Les Fontes au Silicium) Compagnie Générale des Conduites d'Eau. *Revue de Fonderie Moderne,* Vol. 27, Apr. 25, 1933, pages 115-121. This company publishes charts and tables of their 6 kinds of Si cast iron from 3.8 to 6% Si. A eutectoid or slightly hypo-eutectoid cast iron showed excellent mechanical properties and a ferritic structure. The resistance to oxidation of Si cast irons is good and their deformation improves as they become more ferritic. Ha (11b)

The Story of the Properties of Austenitic Steels. Relationship between Composition, Work-Hardening, Annealing and Intercrystalline Corrosion. L. B. Pfeil & D. G. Jones. *Iron & Coal Trades Review,* Vol. 126, June 16, 1933, pages 930-931; June 23, 1933, page 967; *Engineering,* Vol. 136, July 14, 1933, pages 50-52. From paper read before the Iron & Steel Institute, May, 1933. See *Metals & Alloys,* Vol. 4, Nov. 1933, page MA 342. Ha + LFM (11b)

Upper and Lower Yield Points of Structural Steel (Om över nach undre Sträckgräns hos Byggnadsjärn) Axel Lundgren. *Report* No. 53, *Swedish Institute of Testing Materials,* 1932, 48 pages. See *Metals & Alloys.* Vol. 3, July 1932, page MA 198. BHS (11b)

Corrosion Resisting Steels. *Edgar Allen News,* Vol. 11, Apr. 1933, pages 236-239. The development of Maxilvry malleable, stainless steel is described. It is an alloy of Fe with a large % of Ni and Cr and with or without a small % of Cu or Mo. 6 different grades are manufactured; the steel can be welded with oxy-acetylene, for which directions are given. Applications are illustrated. Ha (11b)

Standard Specifications for Carbon-steel and Alloy-steel Blooms, Billets and Slabs for Forgings. *American Standards Association A.S.A. No. G9.1-1933; American Society for Testing Materials Designation: A17-29* 5 pages. AHE (11b)

3 Per Cent Chromium Steel Castings Combine Toughness and Hardness. *Steel,* Vol. 92, Jan. 9, 1933, page 20. Electro Metallurgical Co. has developed a steel possessing toughness, hardness, and good machinability. Castings containing 0.36% C, 0.23% Si, 0.41% Mn, and 3% Cr had a Brinell hardness of 447 when oil quenched from 1650° F. Annealed hardness was 163. Properties after a draw of 1100° F. following the oil quench were: tensile strength, 146,900 lbs./in.^{2}; elastic limit, 109,500 lbs./in.^{2}; elongation in 2 in., 10%; reduction of area, 29.9%; and Brinell hardness, 280. MS (11b)

Symposium on Cast Iron. *Prepared by Joint Advisory Committee of American Foundrymen's Association and American Society for Testing Materials.* H. Bornstein, Chairman, 1933. 164 pages, 85 figures, 115 references. Reprint from Vol. 33, Part II, 1933, A.S.T.M. The engineering properties of cast iron, including soft, gray irons, high strength irons, alloy irons, chilled irons, austenitic irons, and heat-treated irons, are given fully, concisely, and clearly. The discussion of the relation of various measures of strength to different types of engineering application is especially valuable. The designer will find the symposium very helpful for not only does it point out the properties of the various types of iron available—and the high-class properties of modern iron will amaze many designers—but also some of the matters to be watched in designing a casting so that it can be made sound and cheaply. The metallurgist will find a clear discussion of the effects of composition and cooling rate on structure and properties. Very few people know so much about cast iron that their knowledge cannot be added to and their ideas clarified by study of this symposium. Such subjects as growth, endurance, wear, machineability, corrosion, and welding are discussed concisely, but in a highly illuminating fashion. Preparation of the material in so complete, authoritative and brief a form, was a difficult task, requiring much attention from many leaders in the cast iron industry. The time was well spent, for every producer and user of cast iron will be able to make and use it more intelligently because of this publication. It is to be classed among the summaries indispensable to the engineer and metallurgist. HWGp (11b)

Effects of Columbium in Chromium-nickel Steels. Frederick M. Becket & Russell Franks. *Metals Technology,* Jan. 1934, Technical Publication No. 519, 14 pages. Austenitic Cr-Ni steels containing different amounts of C were held for long times at temperatures between 300° and 900° C. Resistance to boiling, acidified $CuSO_4$ and Izod impact values were then determined. Holding in the vicinity of 500° C. made the steels susceptible to disintegration in the $CuSO_4$. Holding at higher temperatures, 650° C. or above, lowered Izod values but did not decrease resistance to $CuSO_4$. Micrographs show that the precipitate (supposedly carbide) formed at the lower temperature tends to take the form of a continuous phase in the grain boundaries. At higher temperatures the precipitate tends to agglomerate. It is suggested that the precipitates formed at the 2 temperatures are not identical in composition. Dilatometric heating and cooling curves were obtained in which the temperature was increased or decreased in steps of 25° C. and held constant at each step for 24 hr. Curves for ordinary steels of the 18-8 type showed critical points near 550° C. On heating one sample, the change began at 515° C. and ended at 590° C.; on cooling, the change began at 565° C. and was completed at 490° C. Addition of 1.16% Cb to an 18-8 steel containing 0.10% C. suppressed the critical points. The addition of Cb in amounts of from 7 to 10 times the C content prevents intergranular embrittlement resulting from heating for long periods. To prevent weld-decay, Cb in amounts of from 4 to 5 times the C content must be added to steels containing 0.10 or less C, and from 6 to 7 times the C content for steels containing 0.13% C. JLG (11b)

The Effect of Tin as an Impurity in Mild Steels. J. H. Andrew & J. B. Peile. *Iron & Steel Institute,* Advance Copy No. 2, Sept. 1933, 9 pages; *Iron & Steel Industry & British Foundryman,* Vol. 7, Oct. 1933, pages 26-28; *Iron & Coal Trades Review,* Vol. 127, Oct. 20, 1933, pages 596-597. Two series of steels containing increasing amounts of Sn were made. One series, made by the crucible process, contained 0.3% C and up to 0.63% Sn. The other, made in an induction furnace, contained 0.2% C and up to 0.40% Sn. Tensile and impact tests were made on the heat-treated steels. The maximum amount of Sn did not affect the tensile properties, but the smallest amount of Sn lowered the impact resistance. Steels containing over 0.2% Sn had a very low shock resistance. The bad effect of Sn in quenched steels is less pronounced after tempering at 620° C. Sn seems to bring about temper brittleness. Thermal curves indicated that Sn raised the Ac_1 but not the Ar_1. Experiments involving diffusion of molten Sn into steel were made in order to explain the injurious influence of Sn; the work indicated that the effect was probably due to Sn decreasing the solvent power of ferrite for Fe_3C. An appendix describes a volumetric and a gravimetric method for the determination of Sn. Ha + CHL + JLG (11b)

Threading Dies—Their Manufacture and Cutting Efficiency. J. G. Morrison. *Iron Age,* Vol. 131, Jan. 19, 1933, page 129, adv. sec. page 12; Feb. 23, 1933, pages 314-315, adv. sec. page 10. Practically all threading dies are made of high-speed steel. The 18% W, 4% Cr, 1% V style is best suited. Co steels are inferior to the 18-4-1 type. The 14% W, 4% Cr, 2% V type as well as the various Mo types have not found favor because they do not possess "refractoriness." C is the factor determining hardness and brittleness of high-speed steel. By the use of steels that vary only slightly in C content from heat to heat, there is better assurance of uniformity of final product. Discusses experience of Landis Machine Company in purchasing uniform material. Second installment gives results of investigations of the effect of Ni on high-speed steel, of the harmful results of carburization and of the use of furnaces with regulated atmospheres for heat treating high-speed steels. Tabulates Rockwell hardness tests. VSP (11b)

Effect of Alloys in Cast Iron. R. C. Good. *Foundry,* Vol. 61, Feb. 1933, pages 24-25, 54. From a paper read before Pittsburgh section of the American Foundrymen's Association. Outlines principal alloying agents used in the foundry, either separately or in combination. Systematic application of definite principles is important in the use of alloying elements in cast Fe, if maximum utility is to be realized in the resulting casting. VSP (11b)

American Progress in the Use of Alloys in Cast Iron. F. B. Coyle. *Foundry Trade Journal,* Vol. 49, July 6, 1933, pages 6-11; July 13, 1933, pages 19-22; July 20, 1933, pages 35-37. Comprehensive paper, illustrated by 21 diagrams and 22 tables. Deals first with historical aspects of the subject, then discusses means for promoting grain refinement in cast iron, for reducing internal shrinkage or porosity, for eliminating chill and hard spots, for improving machinability, and for increasing hardness and resistance to wear. Fundamental characteristics of high-test cast iron are considered, and attention is directed to its heat-treatment, particularly annealing, hardening, and quenching followed by tempering. Corrosion-resistant and heat-resistant cast irons are discussed. OWE (11b)

Some Investigations and Observations on the Strength Properties of Cast Iron. J. E. Hurst. *Metallurgia,* Vol. 8, Oct. 1933, pages 179-180; Vol. 9, Nov. 1933, pages 17-18; Dec. 1933, pages 43-45. Data are cited to show that both composition and properties of castings from a cupola vary markedly from cast to cast. Modulus of elasticity, or more properly the EN value, is discussed at length. This value may vary from 5 to 30 million lbs./in.^{2}. It is greatly influenced by structure, white iron having a high value. Properties of some centrifugally cast piston rings are listed; superheating iron for these rings increased strength and EN value but decreased ductility. Herbert hardness tests on some samples are reported. JLG (11b)

The Influence of Rolling and Annealing Upon the Properties of Mild Steel Sheets. C. A. Edwards. *Proceedings South Wales Institute of Engineers,* Vol. 49, Jan. 10, 1932, pages 371-405; *Iron & Coal Trades Review,* Vol. 127, Dec. 15, 1933, page 903; Dec. 22, 1933, page 941; Dec. 29, 1933, page 980. Size and shape of the crystals in mild steel have a marked influence upon mechanical properties of the metal. Best results are obtained when the crystals are small and more or less perfectly "equi-axed." Most important factors governing the size and character of the crystals in mild steel sheets are the annealing temperature and the degree of cold-rolling previous to the final low temperature or "white" annealing. A perfect structure can be produced only by heating to above 900° C. followed by moderately quick cooling. In ordinary, commercial pot annealing, such temperatures can not be attained without serious trouble from "stickers." A close approximation to such ideal structures is produced by heavy cold rolling followed by low-temperature annealing. In order to improve the final quality by cold rolling and annealing, it is necessary to produce an elongation in rolling of not less than 40%, and better results are obtained with 100% elongations. A steel of S 0.095% and P 0.060% given 100% elongation in cold rolling followed by white annealing between 650° and 750° C. will yield finished sheets considerably better than those obtained from good deep stamping quality steel using present-day methods. With certain critical intermediate degrees of cold-rolling, for example 10 to 30% elongation, extremely poor results may be obtained if annealing is carried out between 700° and 900° C. Beneficial effects of heavy cold rolling cannot be achieved if the steel is annealed when only half the cold rolling has been put on it.
Ha + AHE (11b)

Effect of Some Factors on the Mechanical Properties of Basic Converter Mild Steel (Influence de Certains Facteurs sur les Caractéristiques Mécaniques de l'Acier Doux Thomas) L. Faure. *Arts-et-Métiers,* Vol. 85, Oct. 1932, pages 366-374. Author has studied the following factors: (1) effect of P segregation on tensile strength and elongation of two rolled, basic converter, mild steels; (2) effect of forging with low reduction on the same rolled steels in the two cases, (a) final forging temperature, 825° C. (b) final forging temperature, 725° C.; (3) effect on elongation of deformations of the segregated part through forging. Conclusions are summarized below. (1) Segregated steel shows, in the as-rolled state, good properties lengthwise, but low shock resistance; it should not be used if it is to be subjected to shocks, high transverse compression or work-hardening conditions; i.e., it must be used only for structural members serving under well defined conditions. For making "quality parts" it is necessary to cut off the segregation in the ingot head amounting to about 35%. (2) Annealing lowers the strength of steel rolled at a low rolling temperature of 850° C. High final rolling temperature imparts a coarse texture and must not be employed when good mechanical properties are sought, despite the advantages as to roll wear, accuracy in profiles and power consumption. Basic converter steel responds to forging treatment. A steel submitted to forging with low reduction, after annealing and slow cooling possesses higher strength than a rolled steel having equal elongation. When forgings are to be machined, segregated steel must be avoided. Rolling gives a pronounced, lengthwise orientation to crystals which is detrimental to strength in the transverse direction. Forging permits deformation in all directions. This "kneading" of the metal, which may be harmful if the segregation is not cut off, is beneficial for pure steel. A forged piece may be more heterogeneous than a rolled one but since the structure is broken up the whole member may be improved. FR (11b)

Alloy Modifications of 18-8. John A. Mathews. *Metal Progress,* Vol. 24, Sept. 1933, pages 13-17. The author discusses various additions to 18-8 and their effects upon properties. Addition of about 3% Si increases the resistance to oxidation at high temperatures, improves the welding qualities and where delta iron is formed acts as an inhibitor of intergranular corrosion. Properties of two steels [illegible]hich 2.6% and 3.7% W have been added are given. W is useful for decreasing the susceptibility to intergranular corrosion and for increased strength at high temperatures. Mo is added in amounts of 2%-4%; it has both the beneficial effects of W and also increases the resistance of the alloy to certain corrosives, particularly sulphurous acid and sulphite liquors. In the author's experience W has never lowered the chemical resistance of the alloy. A few creep values at temperatures up to 1600° F. are given. Use of Ti as a stabilizer against intergranular corrosion is discussed. The author has found a properly balanced composition effective in reducing the susceptibility of 18-8 to this attack. WLC (11b)

Adding Chromium to Cast Iron and Its Effects. F. W. Meyer. *Iron Age,* Vol. 131, Mar. 9, 1933, pages 392-395. Does not attempt to cover all effects of Cr on cast Fe. Data given are from actual practice. Cr affects different types of Fe in different degrees, and intensity of this effect is largely governed by the C-Si ratio. Cr is added in form of briquets giving a high % of recovery. Results of investigation showed that optimum amount of Cr would increase with Fe the composition and thermal history of which indicated a tendency toward graphitization. Cr exerts no influence on sensitivity to wall thickness but it increases wear and heat resistance. Experiments with grate bars confirmed the fact that Cr retards growth which ordinarily accompanies exposure of regular cast Fe to heat. VSP (11b)

The Thermal Conductivity of Wrought Iron, Steel, Malleable Cast Iron and Cast Iron. J. W. Donaldson. *Iron & Steel Institute,* Advance Copy No. 6, Sept. 1933, 20 pages; *Iron & Coal Trades Review,* Vol. 127, Sept. 15, 1933, page 395. Thermal conductivities for mean temperatures from 80° to 450° C. were determined. Values given below are for a mean temperature of 100° C. and are expressed in cal./cm./sec. Conductivities decreased with increasing temperatures. Conductivity of wrought iron was 0.175. Five steels in the normalized condition were tested. Their conductivity fell from 0.160 to 0.117 as the C increased from 0.10 to 1.09%. It is pointed out that the fall in conductivity with increasing C is due to the low conductivity of cementite. Pearlite appears to have a conductivity of 0.124 and pure iron 0.174. Blackheart malleable had a conductivity of 0.150 and whiteheart malleable 0.115, difference being due to difference in combined C content. Three cast irons tested contained 3% C and 1.87, 2.81 and 4.20% Si; the conductivities were 0.113, 0.105 and 0.098, respectively. A "Silal" iron containing 2.75% C and 6.49% Si had a conductivity of 0.089. A "Nicrosilal" iron containing 1.81% C, 6.42% Si, 18.65% Ni, and 2.02% Cr had a conductivity of 0.071. Tests of 3 irons containing from 0.18 to 0.95% P showed that the influence of P is to produce a slight decrease in conductivity. 5 references.
Ha + JLG (11b)

Relations of Strengths of Cast Iron with Various Types of Stresses (Ueber die Beziehungen der Festigkeiten des Gusseisens bei verschiedenen Beanspruchungsarten) A. Leon. *Die Giesserei,* Vol. 20, Sept. 29, 1933, pages 434-439; Oct. 13, 1933, pages 460-464. The many empirical relations which have been derived for the various types of strength of cast Fe are discussed with respect to their sufficiency for elucidating the characteristic stress which can be used as a measure of fracture stress. Mohr's theory is found not quite satisfactory as it postulates that tensile as well as compressive tests lead to shear fracture, which is not true for the latter test nor for either test in brittle materials. Reliable empirical figures for cast Fe giving the ratio of tensile, to shear and torsion strength, can be derived only for a material in which compressive and tensile strength have a definite ratio. The strength for all other stresses can, however, be calculated if the compressive strength and the inclination of the fracture surface is known or determined; here Mohr's theory gives fairly accurate values for shearing and torsion strength. Other theories of Scholl, Moersch, Duebi, Foeppl, etc., are discussed; these are valid with certain limitations. 18 references. Ha (11b)

Titanium and Columbium in Plain High-chromium Steels. Frederick M. Becket & Russell Franks. *American Institute Mining & Metallurgical Engineers, Technical Publication* No. 506, Oct. 1933, 14 pages. The addition of Ti or Cb to low-C Cr steels raises the Ar_1 point and therefore tends to overcome air-hardening tendencies. Effects of Ti and Cb on the mechanical properties of steels containing from 5 to 18% Cr were studied. Proper amounts of either of these elements increase ductility and decrease hardness. Ti and Cb are particularly effective in increasing the ductility of the as-rolled material. A steel containing 5.41% Cr, 0.11% C, and 0.75% Ti in the as-rolled condition had a Brinell hardness of 163, an elongation of 18% and a reduction of area of 68%. A similar steel without Ti had a Brinell hardness of 375. Ti decreases scaling at elevated temperatures. A Ti-treated steel containing 5.93% Cr withstood a load of 10,250 lbs./in.^{2} at 538° C. without creeping more than 1% in 10,000 hr.
JLG (11b)

The Influence of Beryllium on Steel. J. H. S. Dickenson & W. H. Hatfield. *Iron & Steel Institute, Advance Copy* No. 5, Sept. 1933, 23 pages; *Iron & Coal Trades Review,* Vol. 127, Oct. 13, 1933, pages 556-557; Oct. 20, 1933, pages 587-590. Of several methods tried, the only satisfactory one for adding Be to steel was to pour lumps of Be into a stream of the liquid. Approximately 1% of Be was added to C and alloy steels. Tests were made to determine the influence of Be on structure, critical points, forging characteristics, and mechanical properties. The alloy steels were: 13% Cr steel; 18 Cr-8 Ni steel; 3.6% Ni steel; 3.5% Ni-0.80% Cr steel. The alloys were given various heat treatments. Be tended to make steels stiffer during forging, particularly the 3.6% Ni steel. Precipitation hardening, as indicated by a peak in the hardness versus tempering temperature curve at 400 or 450° C., was observed. Be decreased the corrosion resistance of the 18-8 Cr-Ni steel. Inclusions in Be steels contained Be; BeO evidently displaced some Al_2O_3. It was concluded that: "The results disclosed by this investigation indicate little or no prospect of the element Be becoming a useful addition to the group of metals used in the manufacture of special steels. The metal is extremely expensive, and is unlikely ever to become reasonably cheap, whilst its lightness and readiness to oxidize make the actual introduction into molten steel somewhat difficult and distinctly wasteful, even with the special method of addition employed in the present case." JLG (11b)

Critical Comments on the Bending Test and Suggestions for a Combined Testing Method for Unalloyed Cast Iron (Kritische Betrachtungen über die Biegeprobe und Vorschläge über ein kombiniertes Prüfverfahren beim unlegierten Gusseisen) A. Gimmy. *Die Giesserei,* Vol. 29, June 9, 1933, pages 235-240; July 7, 1933, pages 280-286. Exhaustive investigations have shown that no relation exists between bending strength and tensile strength, and that with a given bending strength the ultimate deflection is related to tensile strength. The coefficient of graphite formation of Thum is related to tensile strength which latter is a function of graphite formation. A new diagram was developed showing the relation of tensile strength to hardness; the constants in this ratio are called isoflexes, as in the Thum diagram. The isoflexes give valuable indications of the relation of machinability to hardness and tensile strength and also show the similarity of cast iron to steel; furthermore they offer a reliable comparison for impact bending tests. All these relationships are fully discussed and illustrated by curves from test results. 21 references. Ha (11b)

The Mechanical Properties of Malleable Iron with Particular Regard to Its Grain Size (Ueber die mechanischen Eigenschaften des Tempergusses unter besonderer Berücksichtigung seiner Korngrösse) F. Loepelmann. *Die Giesserei,* Vol. 20, Sept. 1, 1933, pages 366-372. Improvements in quality of malleable iron made in the last years are reviewed; systematic experiments developed a new heat treatment which permitted obtaining a very fine grain in an iron originally of very coarse grain. This also enabled the carrying out of the malleableizing process at a higher temperature and in a shorter time than heretofore since the coarse grain due to the high temperature could be refined by the new heat treatment. The latter consists in heating the raw casting quickly to 1050° C., annealing it at this temperature until the eutectic carbides have disintegrated, cooling below A_1, heating until the α-solid solutions have been completely dissolved, annealing for a short time above A_1 and then below A_1 and cooling in water. The whole process does not consume more than 12 hrs. Castings treated in this manner had excellent mechanical properties which were fully equal, and even superior in elongation, to well annealed steel. The material is recommended to replace small steel castings because of its lower price and equal quality. 15 references. Ha (11b)

Temperature Coefficient of Elasticity Modulus of Ferromagnetic Materials (Ueber den Temperaturkoeffizienten des Elastizitätsmoduls ferromagnetischer Stoffe) M. Kersten. *Zeitschrift für Physik,* Vol. 85, Oct. 14, 1933, pages 708-716. Theoretical investigation of the increase of the elasticity modulus by magnetization and its dependence on temperature. Leads to the conclusion that the temperature coefficient of ferromagnetic substances must become zero under definite conditions of magnetism and natural internal stresses. This explains the fact that the so-called "Elinvars," Fe-Ni alloys with 30-40% Ni and other small additions can be produced with substantially zero temperature coefficient; the latter disappears at a certain definite hardness which is obtained by precipitation of a non-soluble component from an undercooled solution at a certain annealing temperature. The relations between magnetization, magnetostriction and internal stresses are defined. 21 references. Ha (11b)

"All-Mine" Irons for Cylinder Castings. J. C. JONES. *Iron & Steel Industry & British Foundryman,* Vol. 6, Apr. 1933, pages 237-238. The "All-Mine" irons are special low C irons of virgin metal to which no scrap has been added. They are guaranteed to be of uniform analysis with total C contents as low as 2.40%. They are used in foundries producing automobile and Diesel engine cylinders, rolls, brake drums, and ingot molds since they combine high strength, moderate hardness and resistance to heat. CHL (11b)

High-Strength and Wear-Resistant Malleable Cast Iron. REBECCA HALL. *Transactions American Foundrymen's Association,* Vol. 41, 1933, pages 112-126. **Wear Resistance of Malleable Iron.** *Foundry,* Vol. 61, July 1933, pages 28-29, 62, 64. The properties of malleable cast Fe containing Cr plus an excess of Si were studied. Alloy additions were made to standard metal, and the castings given a regular anneal. The Cr ranged from 0.25 to 1.15% with the Si varying from 1.02 to 2.02%. Maximum tensile strength was secured with 0.84% Cr and 1.57% Si. Elongations decreased with Cr and the hardness increased. Elastic limits increased up to 62,500 lbs./in.^{2} VSP + CHL (11b)

The Heat Content of the Austenite-Pearlite Transformation (Die Wärmetönung der Austenit-Perlit-Umwandlung) HANS ESSER & W. GRASS. *Stahl und Eisen,* Vol. 53, Jan. 26, 1933, page 92. Recent tests made on a eutectoid steel using a metal block calorimeter. Heat of transformation for the austenite → pearlite reaction was found to be 21.22 cal./g. The value of 16.1 cal./g. previously determined can be attributed to errors due to the apparatus. 4 references. Ha (11b)

The Remanence of Iron Monocrystals (Ueber die Remanenz von Eiseneinkristallen) S. KAYA. *Zeitschrift für Physik,* Vol. 84, Aug. 21, 1933, pages 705-716. On the basis of measurements on differently oriented Fe monocrystals the remanence of the latter can be represented by $1\infty/(1+m+n)$ where 1∞ is the saturation magnetization and l, m, n the cosine of the direction of the exterior field against the sides of the cube. The more perfect a ferromagnetic crystal the smaller becomes its coercive force while its remanence remains approximately constant. Ha (11b)

On the Thermal Conductivity of Tool Steels. D. HATTORI. *Kinzoku no kenkyu,* Vol. 10, Sept. 1933, pages 409-422. Thermal conductivity of some carbon tool steels, special tool steels and high speed steels was measured by an apparatus of calorimetric principle. Effects of quenching and tempering on conductivity were also measured. When quenched high speed steels were tempered at 550°-600° C. the conductivity increased by 50-80%. This agrees very well with the fact that durability of high speed steel tools tempered at 550°-600° C. is greater than that of quenched tools. KT (11b)

Pig-Iron with Higher Manganese Content J. L. FRANCIS. *Foundry Trade Journal,* June 15, 1933, pages 416 and 418. After pointing out that pig-irons containing a Mn content in excess of 1.5% are rarely marketed, author states that the wide-spread belief that Mn is a drastic hardener of gray iron is scarcely justified by the facts. The dangers due to lack of Mn are in general greater than those due to what is considered at present an excess. OWE (11b)

Recent Advances in the Knowledge of Engineering Materials. J. NEILL GREENWOOD. *The Commonwealth Engineer,* Vol. 21, Aug. 1, 1933, pages 5-6. Lecture given at the combined meeting of the Australasian Institute of Mining and Metallurgy and the Melbourne University Metallurgical Society points out the importance of fatigue and corrosion fatigue in determining the strength of metals. It shows that the ultimate tensile strength is of little value in determining the safe load which a member of a machine or structure can bear. A material having high ultimate strength may fail under quite low working stress when that stress is continually undergoing reversal, and when corrosive conditions are present. Tables are presented collecting data on corrosion fatigue limits of steels and non-ferrous alloys as determined by McAdam. Balance of the paper deals with creep in metals operating at elevated temperatures. WH (11b)

Air-Furnace Cast Iron. DUNCAN P. FORBES. *Transactions American Foundrymen's Association,* Vol. 41, 1933, pages 51-65. Design of furnaces and methods for making cast Fe in an air-furnace are described. Duplexing with cupola and air-furnace takes advantage of the low melting costs of the cupola and the refining action of the air-furnace to produce high quality gray Fe and alloy cast Fe. C contents of irons are limited to about 2.60%. With less C the graphite forms in a dendritic arrangement which promotes brittleness. Air-furnace Fe of 50,000 lbs./in.^{2} tensile strength is said to possess a Brinell hardness of 200, whereas Fe of the same strength from an electric furnace has a hardness of about 220. CHL (11b)

Dependence of Elastic Modulus and Damping of Ferromagnetic Substances on the Intensity of Magnetization (Uber die Abhängigkeit des Elastizitätsmoduls und der Dämpfung ferromagnetischer Stoffe von der Magnetissierungsintensität) O. v. AUWERS. *Annalen der Physik,* Series 5, Vol. 17, May 1933, pages 83-106. Investigations with soft and hard Ni, Fe, steel and Ni-Fe alloys showed that the change of modulus of elasticity is greater the softer the material, and smaller the less the magnetostriction. The damping of magnetically saturated ferromagnetic materials shows a pronounced minimum and the change in the modulus of elasticity a corresponding maximum. The maximum of damping coincides with the maximum of the alternating magneto-elastic stress. Both modulus and damping have a range of hysteresis which is limited to inductions below the maximum damping. Ha (11b)

Electric Alloy Steel Castings (Les moulages en aciers électriques spéciaux a l'Union des Acieries de Marcinelle, Belgique). E. DECHERF. *Journal du Four Electrique,* Vol. 42, Sept. 1933, pages 317-323. Generalities. A steel is mentioned having $C+Ni+Cr \geqq 5.3\%$ and some Mo which is air hardening and is claimed to be better for track work than Hadfield steel. JDG (11b)

High-Grade Chromium-Nickel Alloys and the Testing of their Life (Hochwertige Chrom-Nickellegierungen und deren Lebensdauerprüfung) W. HESSENBRUCH & W. ROHN. *Elektrowärme,* Vol. 3, Aug. 1933, pages 245-249; Sept. 1933, pages 294-297; Oct. 1933, pages 317-322; abstract, *Metallurgia,* Vol. 8, Oct. 1933, pages 181-188. Methods for production of Cr-Ni alloys for resisting high temperatures are described; physical properties, chemical resistance, influence of frequency of switching current on and off, and metallographic investigations of the various alloys are discussed. Almost all Fe-containing Cr-Ni alloys, when used at high temperatures, show in course of use a segregation of a ternary compound of Fe-Cr-Ni while in the unused state the alloy consists of solid solutions of Ni-Cr-Fe-Mn-Si; the segregation takes place both at the grain boundaries and within the grains, and increases with Cr content. These conditions are illustrated by etching. JLG + Ha (11b)

Tensile Strength of Cast and Forged Steel, and Comparison of Impact Values. ZENICHIRO TAKAO. *Suiyokwai-shi,* Vol. 7, Nov. 25, 1932, pages 171-176. Properties of cast and forged steels whose C contents were respectively 0.2-0.5% and 0.22-0.63% were examined and change of tensile strength with C content and test values with different impact machines were obtained. Tensile strength increases and impact value decreases with rise of C content. Cast and forged steel showing equal Izod values present a similar Charpy value notwithstanding size of testing machine, while forged steel shows a higher Charpy value tested with a larger machine than that of cast steel, even if they show a similar value in Izod and smaller Charpy machines. HN (11b)

Brittleness Under Slowly Creeping Stress. ERNEST E. THUM. *Metal Progress,* Vol. 22, Sept. 1932, pages 43-47. Certain aspects of the failure of the heat treated wire first used in erecting the Mount Hope Bridge are discussed. The results of extensive examination of this material indicates that the troostitic structure of the heat treated eutectoid steel is unyielding and brittle under creeping loads. Diagrams of the sheaves and the stresses set up are included. WLC (11b)

Alloys of Iron and Molybdenum. J. L. GREGG. McGraw-Hill Book Company, New York, 1932. Cloth, 6x9¼ inches, 507 pages. Price $6.00. This book by J. L. Gregg is an outstanding contribution in at least two respects, first it is a very satisfying reference work, and second it sets a new high standard for manner of presentation of data. The book is the first of a series to be known as "Alloys of Iron Monographs," and it will be satisfying indeed if the rest of the series come up to the standard set by the first volume.

A valuable feature in the book is the author's summary at the end of each chapter. It is in the nature of a brief critical review and aids the reader in securing perspective on the contents of the chapter.

Another departure from previous texts, and a departure to be recommended highly, is the inclusion of contributions showing "practical" applications. Such data as those contributed by Chase on forgings, d'Arcambal on high speed steel, Johnson on aircraft materials and Emmons on twist drills appear very useful indeed. Many text books, in their zeal to present certain fundamentals, either overlook or minimize the complexity of related subjects. By contrast, this volume brings to light the tremendous number of aspects encountered in the industrial and scientific development of this single chemical element.

Of course it is always possible to pick flaws, and the following few comments are offered to satisfy the quaint time-honored belief that a review must contain a little adverse criticism. It would probably be useful to cross-index the text itself as completely as possible. Thus on page 5 one wonders why chrome molybdenum SAE 4100 steels are mentioned without referring to nickel molybdenum SAE 4600, only to find that the two are mentioned together on page 82. Similarly, undue mention is made of "molyte" on page 17, and one wonders about calcium molybdate, only to find that calcium molybdate is discussed rather fully on page 70. One wonders also why the molybdenum steel diagram on page 63 is included, unless it be for the sake of historic interest. Finally in the discussion of segregation on page 75 an implication there should not be allowed to pass unchallenged. While it is quite true that molybdenum was found to segregate in an ingot weighing 119 tons, it should be pointed out that the vast majority of molybdenum steels are cast in ingots weighing not over 5 tons, and that molybdenum does not segregate appreciably under these conditions.

These minor shortcomings cannot be said to detract appreciably from the book which is otherwise of a very high order. M. Grossmann (11b)-**B**-

The Alloys of Iron and Silicon. EARL S. GREINER, J. S. MARSH & BRADLEY STOUGHTON. McGraw-Hill Book Company, New York, 1933. Cloth, 6x9¼ inches, 457 pages. Price $5.00. This is the second publication of the proposed monograph series on iron alloys sponsored by the Engineering Foundation, and prepared under the supervision of its Iron Alloys Committee. The first publication, it will be remembered, was that of the Iron-Molybdenum series.

In appraising the organized work of such tremendous scope, and realizing the responsibility which such work carries, the reviewer must not be tempted to resort to comparison: In the first place because most of our metallurgical books are notoriously broad in the subject they try to cover, and, secondly, because in many cases they present the views of the authors rather than the critical survey of the existing knowledge. The present volume *is* a critical and clearly an unbiased survey: The views of the authors, when presented for the reader's consideration, are meant to occupy a secondary place. Upon reading the iron-molybdenum and iron-silicon publications one is at once convinced that no set standard is to be used in publishing these monographs and that the method of presentation and digest of each series of alloys is to be in strict accordance with the available and dependable informative data.

The contents of the book fulfill admirably the expectations of the reader: The manuscript gives a complete (1200 articles in many languages were studied and abstracted) and, as has been stated, critical summary of the subject, with facts and data on major topics discussed at length; it contains an invaluable bibliography; and it clearly indicates the existing gaps in our knowledge—a feature of much importance to the engineering metallurgist and research worker alike. This, as stated by the authors, was their aim. But, in addition, the book contains most valuable chapters dealing with binary and ternary diagrams of iron-silicon and iron-silicon-carbon alloys. The latter is especially important because it contains both the description and the application of the basic principles involved in the studies of ternary systems in equilibria. Yet it is these chapters that might be criticised by the attentive reader, not altogether conversant with the materials under discussion: A few more pages devoted to basic principles of equilibrium diagrams would greatly facilitate the reading. Should the second edition of this book be necessary—and it is sincerely hoped that it will be, the elaboration upon these particular chapters may well be considered.

The critical attitude of the authors, maintained throughout the book, is most manifested in the Chapters IV to VII (pages 91-113). It is, unquestionably, an excellent discussion of the important topic concerned with the theory of iron-silicon and iron-silicon-carbon alloys, as well as some of the perplexing phenomena observed during transformations in the solid state: Occasionally, however, the subject matter (see for example, the sub-topic on the thermodynamics of transformations) suffers from the regrettable brevity, which, in some instances, is detrimental even to the clear presentation of the authors' concepts. Perhaps the attitude taken by the authors is justified, at least in certain cases, by the primary purpose of the book; but even though it is fully justifiable, it is regrettable. The same criticism may be directed at chapter two, dealing with high purity silicon, high purity iron, and ferrosilicon. If this subject is considered essential to the value of the book as a whole, then, surely, "pure" iron deserves more than one half page of discussion! An elaboration of this chapter, such, for example, as a list of available irons of high purity would be a definite improvement.

On the other hand one might question the advisability of reprinting, at some length, the material which may perhaps be called historical: Chapter III contains fairly numerous reproductions of the binary iron-silicon diagrams, most of which are now abandoned.

Almost half of the book (Chapters I to VIII, 194 pages) is devoted to the theoretical discussion of the binary, ternary, and more complete alloys with silicon. A few relatively unimportant—and perhaps disputable—shortcomings pointed out, do not, in any way diminish the immense value of this half of the volume.

Subsequent chapters deal with various silicon steels, their manufacture and properties, high silicon corrosion resisting alloys, silicon steel sheet and various special topics of interest to the research worker, engineer and manufacturer. This second, if we may call it so, half of the book is a most comprehensive work, containing complete and critical summary of the existing knowledge. The value of such information, compiled in one volume, is obviously immense: read, for example, Chapters XIV and XV on electric, magnetic, and special properties of silicon steel.

"The Alloys of Iron and Silicon" is a monumental work put in the form of an excellent book. V. N. Krivobok (11b)-**B**-

Effect of Nickel on Nitrided Steels (Effet du Nickel sur les Aciers Nitrurés) L. GUILLET. *L'Usine,* Vol. 42, May 12, 1933, page 27. Investigations on the influence of Ni in nitrided steels are reviewed; Ni increases the resistance and hardens the core of most alloyed steels used for nitriding and contributes to a better support for the hardened case which is relatively brittle when subject to deformation. Ni in Al steels has a particularly important influence as it raises the elastic properties and hardness and somewhat reduces impact resistance, elongation and reduction of area. Softer steels can be used for a given purpose since the core becomes more resistant during nitriding. Toughness of the hardened case is increased by Ni while the maximum obtainable hardness is slightly reduced. More than 1.5% Ni must be added; 2-3.5% gives the best average results. The same good influence has been observed in steels with 1% Al and 1% Cr with or without Mo with 2% or more of Ni. Ha (11b)

EFFECT OF TEMPERATURE ON METALS AND ALLOYS (12)

The abstracts in this section are prepared in co-operation with the Joint High Temperature Committee of the A.S.M.E. and the A.S.T.M.

L. JORDAN, SECTION EDITOR

High Temperature Steam Experience at Detroit. P. W. Thompson & R. M. Van Duzer, Jr. *Combustion,* Vol. 5, Nov. 1933, pages 13-21 (also presented before the A.S.M.E. Steam Power Division, December, 1933). Essentially an article on high temperature service of alloy steels, especially 18:8. An experimental 10,000 kw. turbine was operated at 1000° F. and a superheater and piping system at 1000°-1100° F. Five lots of 18:8 or 18:8 plus Si, a 5% Cr 1% W, a couple of plain Mo steels, a variety of bolting steels, etc., were installed, choices being made on the basis of creep data available in 1927. Some of the service data did not lead to definite conclusions, for example, a cast 1.6% Si 18:8 valve cracked but was found to contain inclusions and blowholes. Similarly, the cast 5% Cr 1% W material, did not show anticipated embrittlement in high temperature service, but the initial impact was so low and the casting so full of inclusions that the results were indecisive. Nitrided steel did not serve well for valve trim, material initially of 1000 Vickers Brinell falling to 470-700. Scale formed and the surfaces pitted. Calorized carbon steel, used under severe conditions, developed bare spots and the remaining coating was brittle. The application of a more ductile Al coating upon alloys of better creep resistance is still considered promising. The best bolt material tried was a .45 C, 1.25 Cr, 2% W, 0.25% V steel, heat-treated to 215-225000 lbs./in.^{2} tensile strength. After over 4000 hours at 1000°-1100°,F. the hardness dropped somewhat but the tensile properties were scarcely altered. After about 8,000 hours at 1000° F., however, the tensile strength dropped to 163,000 lbs./in.^{2}, ductility increased and impact dropped a little. Bolts of 0.05% C, 20 Cr, 10 Ni, 2.3% Si had too low elastic strength, and were severely embrittled. The time of service of these is not definitely stated. Bolts of .36% C, 0.50% Cr, 1% W steel showed a 50% drop in impact, and these and other bolts of rather similar steels required tightening to compensate for creep. A .50% C, 1.30% Cr, 2.60% Ni, 0.60% Mo steel showed more satisfactory results. Some cast Ni-Cr-Mo material in the turbine, which according to previous work of Bailey in England, should become embrittled, did not embrittle in 200 hours at 1000° F., even when heated under a load of 12,000 lbs./in.^{2} Creep data on some of the materials during actual service is recorded, but some attempts to secure such data were abortive because of slight warpage. The indications are, however, that for some of the parts the design stress, based on 1% creep in 100,000 hours, was more conservative than necessary. Probably the most interesting results are those recorded on 18:8 tubing after service. One such steel of about 0.06% C after some 5,000 hours at 1000°-1100° F. of which about 3000 were at 1100° F., showed only negligible changes in tensile strength, hardness or impact, though ductility fell somewhat, and electrical conductivity after boiling 48 hours in H_2SO_4-$CuSO_4$ solution, to measure susceptibility to intergranular corrosion, changed 60%. Another specimen of 0.09% C, after some 13,500 hours at 1000°-1100° F., of which 10,000 were at 1100° F., showed no appreciable change in tensile strength, reduction of area or hardness. Elongation fell somewhat, impact dropped only a little, while the conductivity changed 260%. A third sample with 0.05% C after 20,000 hours at 1000°-1100° F. of which 15,000 were at 1100° F., definitely increased in tensile strength and hardness, retained its original reduction of area, showed only the same drop in elongation as did the 2 specimens not heated so long; its impact had fallen 68%, and its conductivity was the same as the original unheated material. Metallographic examination was made. The micrographs show widening of the grain boundaries, probably less marked in the specimen heated the longest. There was no actual intergranular corrosion in this service. The material heated the longest seems to have shown full recovery from intergranular corrosion susceptibility, though its impact has dropped. The evidence is pretty clear, though the authors do not make the comment, that loss of impact and advent of susceptibility are 2 quite different things. The authors, in spite of the 68% drop in impact, stated that this slow embrittlement is not of sufficient magnitude to cause any concern. They sum up by stating that it is metallurgically feasible now to build a plant to operate on 1000° F. steam, and get reliable service but the economics of such a plant appear doubtful until metallurgical research produces suitable materials at a much lower cost. HWGp (12)

New Bearing Alloy Designed to Withstand High Temperature. *Automotive Industries,* Vol. 69, July 29, 1933, page 122. The National Lead Co., New York has placed on the market the new bearing alloy, Satco bearing metal. It has a higher m. p. than ordinary babbitt metal, is less brittle, and hence less subject to failure in the event of deficient lubrication. It is recommended that Satco soldering flux and Satco No. 70 bonding alloy be used in applying the new alloy to bronze or steel shells. The alloy is admirably suited to die-casting work. It is now used as a lining for the "brasses" of railroad truck and trailer axles. DTRp (12)

A Comparison of Certain White-Metal Bearing Alloys Particularly at Elevated Temperatures. C. E. Swartz & A. J. Phillips. *Proceedings American Society for Testing Materials,* Vol. 33, Part II, June 1933, pages 416-425; *Metal Industry,* London, Vol. 43, Dec. 29, 1933, pages 637-641. The physical properties of the following Sn-base and Cd-base alloys were compared: No. 1, 5.23% Cu, 6.2% Sb, remainder Sn; No. 2a, 3% Ni, remainder Cd; No. 2b 1.35% Ni, remainder Cd. Tensile properties are as follows:

	Temp. ° F.	Ten. Str. lbs./in.^{2}	Y. P. lbs./in.^{2}	Elong. %	Red. of Area %
No. 1.	82	10,400	8,500	10	12
	212	5,900		24	38
	390	1,800		86	76
	570	Alloy molten at 475° F.			
No. 2b.	82	16,400	11,700	19	43
	212	10,500		36	52
	390	3,300		111	76
	570	600		162	78
No. 2a.	82	22,900	16,800	6	6
	212	14,300		13	17
	390	3,300		65	42
	570	700		213	82

The compressive strength of the Cd-Ni bearing alloy is greater at all temperatures investigated than the ordinary Sn-base babbitt. Curves are given. The softening point of the Cd-Ni alloy is higher than that of any Sn-base babbitts now in use. Creep tests indicate a creep limit of around 200 lbs/in.^{2} for the Sn-base alloy as opposed to 2000 lbs./in.^{2} for the Cd-base alloy. Practical tests however show sufficient creep to serve the purpose of alignment in the various installations. The ductilities are about the same. The hardness of the Cd-Ni alloy is greater at all temperatures studied than the hardness of the Sn babbitt. However, microhardness measurements show that the hard constituent is not too hard to act as bearing contact for the softest steel shaft likely to be used. The Cd-Ni alloy unlike other Cd alloys is capable of readily bonding itself to steel, as well as to brass, and bronze, the alloys likely to be used as backing for bearings. Service tests showed a greater load-carrying capacity and higher melting point than for the Sn alloy. Ha + VVK (12)

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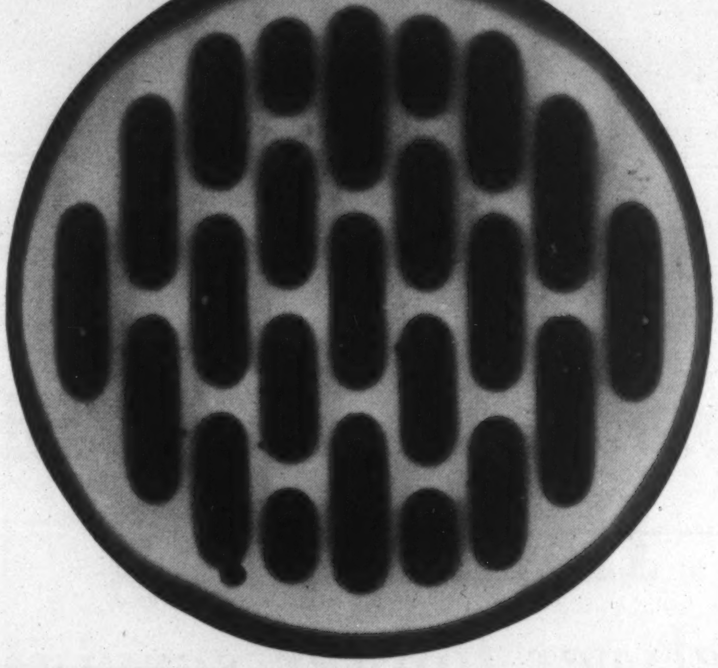

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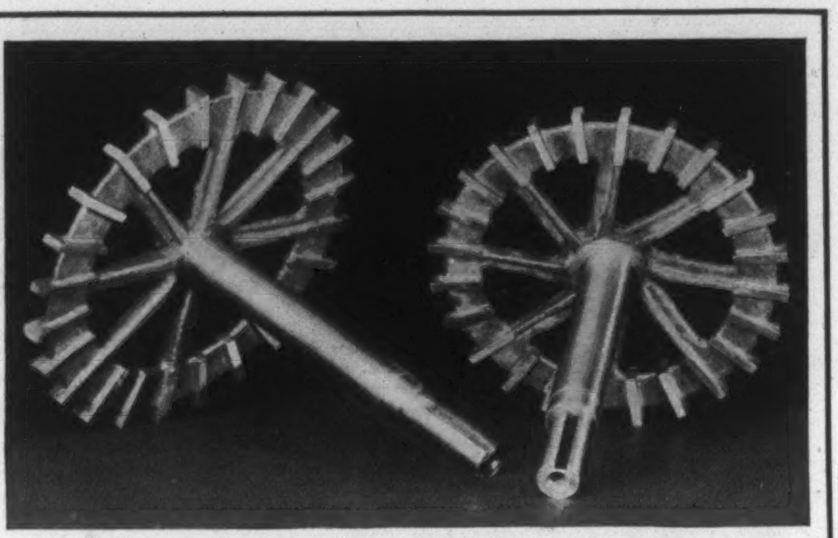

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CORROSION AND WEAR (13)

V. V. KENDALL, SECTION EDITOR

Alloy for Temperatures up to 1300° C. (Widerstandslegierung für Temperaturen bis 1300° C.) A. GRUNERT, W. HESSENBRUCH & K. RUF. *Elektrowärme*, Vol. 3, July 15, 1933, pages 208-212. A new alloy, called "Megapyr," consists of 65% Fe, 30% Cr, 5% Al and can be used safely up to 1200° C. The tensile strength is 130 kg./mm.^{2} when cold and drops to about 70 kg./mm.^{2} at 1200° C. The heat-resistance or life at 1050° C. is twice that of the usual Cr-Ni alloys; at 1200° C. it is about 75 hrs. against 30 hrs. The alloy is also much more resistant against S-containing gases. Sp. gr. is 7.1 (8.4 for Cr-Ni); the spec. resistance is $1.4 \dfrac{\text{ohm, mm.}^2}{\text{m}}$ against 1.1 for Cr-Ni at 0° C. and remains practically constant, being at 1200° C. 1.43 ohms. The surface load (amp./cm.^{2} surface) is higher than for Cr-Ni: at 1200° C. 1.1 against 0.4 resp. for free suspended wires. The refractory in connection with "Megapyr" should contain about 40% Al_2O_3, or even 60% where a great heating capacity is desired in a small space. The alloy can be welded, it can be formed cold and is obtainable in wires up to 8 mm. diam. or in ribbons. Heating elements are illustrated. Ha (13)

Gold as Protection Against Corrosion (Gold als Korrosionsschutz) R. LEONHARDT & P. STEEL. *Oberflächentechnik*, Vol. 10, Apr. 4, 1933, pages 83-85. It was investigated under what conditions gold plating as protection against corrosion was practical. In the first place, it should be used only in cases where no great mechanical stresses are exerted; articles of Fe or steel can be very well protected by Au plating when a Ni layer is applied as intermediary deposit. Au is recommended for its resistance to oxidation, acids and alkalies. Its expansion coefficient is so close to Ni and Fe that no cracks will form at great temperature differences. As it deposits in very small crystals it gives a very dense coating, and adheres extremely well so that spalling is avoided. Further, local elements give a very small potential Fe-Au which is a guarantee against corrosion taking place at lesions of the deposit. The best electrolytes for Au plating are made up with gold-potassium cyanide. Temperature and current density must be low enough not to give rise to H evolution. Ha (13)

Corrosion of Metals Under the Influence of Some Gasolines and Kerosenes. N. I. LADUIZHNIKOVA. *Reports Government Petroleum Research Institute, Moscow*, 1932, pages 139-143. In Russian. Strips of various metals were immersed in gasoline from Ural containing 0.458% S. It reacted heavily with Pb and to a lesser degree with Cu, brass and Fe, while its distillate did not attack brass or iron. A kerosene of the same origin which had 1.684% S attacked all three metals to a much greater extent while the distillate which contained 1.925% S attacked Cu and brass more vigorously and Fe much less than the refined product. After 7 months contact, cracked gasoline from Baku attacked, in decreasing order, Pb, Fe, Cu and brass. The attack was not so severe when keeping the samples in the dark. The above phenomenon is explained by the presence of unsaturated compounds in the cracked gasoline which are oxidized in the presence of metals, the latter acting as catalysts. This gasoline also showed a higher acidity after the experiment. Baku kerosene had a corrosive action on the following metals arranged in decreasing order: Pb, brass, Cu, Fe and Al, the latter was not attacked during the 21 months of the experiments. This phenomenon was accompanied by an increase in the I number, the aniline point and the acidity. Kerosene saturated with water attacked metals in a more severe manner than dry kerosene. AAB (13)

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Protection against Corrosion and Corrosion Resistance of Binary Solid Solutions (Zur Frage des Korrosionsschutzes und der Korrosionsbeständigkeit binärer Mischkristalle) L. GRAF. *Metallwirtschaft,* Vol. 12, Oct. 13, 1933, pages 585-587; Oct. 20, pages 602-603. A review and summary of recent literature on the subject, especially by G. Tammann with 22 references. CEM (13)

Protection of Aluminum and Its Alloys (Protezione dell'Aluminio e Sue Leghe) O. MACCHIA. *L'Industria Meccanica,* Vol. 15, May 1933, pages 410-413. The chemical and electrochemical processes applied to protect from corrosion or to give a better appearance to Al and its alloys are reviewed and described. All methods of protection are only of relative value; this question has not yet found a definite solution. Ha (13)

Theory of Passivity. XX. Passivity of Nickel (Zur Theorie der Passivitätserscheinungen. XX. Ueber die Passivität des Nickels) W. J. MUELLER & E. LOEW. *Zeitschrift für Elektrochemie,* Vol. 39, Nov. 1933, pages 872-879. In a controversy with Georgi it is maintained that all investigations on this subject point to the theory that passivity of Ni can be fully explained by the general laws of passivity both for electrolysis with constant potential and with constant current. Polarization of the surface film depends entirely on the free area of pores and not on the nature of the substance forming the film. Ni is covered with an oxide film with pores which have an aggregate area of about 1/1000 cm.^{2}/cm.^{2} film; metallic Ni is exposed in these pores. A method of photographing the pores is described. 14 references. Ha (13)

Intercrystalline Corrosion in Stainless Steels (Die interkristalline Korrosion in rostfreien Stählen) A. FRY & P. SCHAFMEISTER. *Paper Third Corrosion Congress Verein deutscher Ingenieure, Verein deutscher Eisenhüttenleute, Deutsche Gesellschaft für Metallkunde and Verein deutscher Chemiker, Nov. 14, 1933, Berlin.* Mimeographed report, pages 1-2. Authors first survey intercrystalline corrosion in general as observed in dezincing occurrences, season cracking of brass, caustic brittleness of low C steel and intercrystalline corrosion of austenitic stainless steels. The common causes of all these corrosion occurrences are elucidated, effect of corroding medium, stresses and precipitations along the grain boundaries. In 18-8 stainless steels carbide precipitations along the grain boundaries cause corrosion attack. Remedies are: (1) Decrease of C content below .07% to thus make impossible formation of carbides. (2) Methods of increasing solubility of carbides in austenite are not successful, the other way of binding C to elements forming carbides is most successful. To attain this end Ti and similar elements are added. (3) By suitable hot working and heat treating methods it is possible either to attain precipitation of carbides within the grains where they are not detrimental or to change the composition of the matrix by additions of Ti, Si, etc., to obtain the formation of ferrite with a different C solubility in addition to austenite. By both of these methods decomposition within the grain boundaries can be avoided. GN (13)

Can Metal Surfaces be Passivated? (Kann man Metalloberflächen passivieren?) H. HEBBERLING. *Oberflächentechnik,* Vol. 10, Nov. 21, 1933, pages 257-258. The question is discussed to what extent rusting and oxidation of Fe can be prevented by passivation of its surface on which other protective coats of paint can be applied. According to the theory that metal corrosion is an electrochemical process, rusting of Fe takes place between the potential range of — 0.2 V. (subpassive state) and + 0.4 V. (subactive state); the state of "superactivity" or "cathodic passivity" is characterized by an interval of + 0.5 to + 0.9 V., the state of "anodic passivity" from — 0.2 to — 0.9 V. In the range of these 2 extremes Fe remains absolutely free of rust, in the first case, however, only in the presence of alkaline solutions of low concentration. A number of experiments which have been made to elucidate this behavior and to decide whether such passivation is indeed the reason for non-rusting, are reviewed. Only in the case of Fe embedded in lead superoxide could the existence of a passivating layer be proved with certainty. A practically useful treatment of the surface has so far not been developed. Ha (13)

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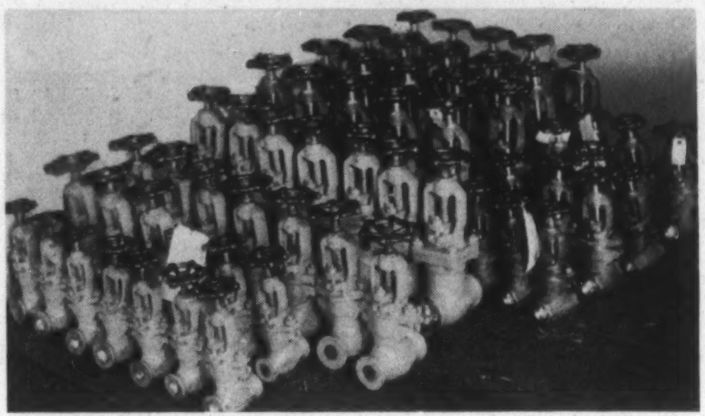

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Damage to Low Pressure Turbine Blading (Schäden an der Niederdruckbeschauflung von Turbinen) W. Osenberg. *Die Wärme,* Vol. 6, July 22, 1933, pages 478-479. Discusses critically one cause of trouble hitherto generally overlooked: the presence of relatively large quantities of CO_2 in the last stages of this kind of turbine. Writer criticizes the softening of boiler water for protecting the boiler without considering the turbine. The presence of 35 mg. CO_2/kg. steam in addition to inleakage of oxygen (air) results in a mixture of highly aggressive character. Remedial measures of preparing the boiler water are considered. EFp (13)

Economic Significance of Pipe Linings. E. T. Killam. *Water Works & Sewerage,* Vol. 80, Mar. 1933, pages 73-76. The capacity of pipe lines is reduced from year to year by "tuberculation," that is, clogging up by sediments and growths on the inside walls. Cement and bituminous linings greatly eliminate this trouble. Methods of lining, figure for proper thickness and savings in actual experience with water and sewer lines are described. Hap (13)

Resistance to Corrosion by Seawater of Certain Aluminum-Magnesium Alloys (Résistance à la corrosion par l' eau de mer de certains alliages aluminium-magnésium) E. Herzog & G. Chaudron. *Comptes Rendus,* Vol. 196, June 26, 1933, pages 2002-2003. Results of accelerated corrosion tests, using 3 methods of attack, on 1 mm. sheets of Al-Mg alloys are described. It has been found that when Si is present in these alloys, they fail because of intercrystalline corrosion if the heat treatment given the material has been such as to cause precipitation of Mg_2Si. The addition of Mn prevents more or less completely the precipitation of Mg_2Si, thus making the alloys more resistant to intercrystalline attack. An alloy containing Mg and only traces of Si, if it contains Cu, undergoes corrosion as a result of pitting. If alloys resistant to corrosion are required, Cu and Si should be eliminated from the composition and the necessary mechanical properties secured by the addition of Mg. Alloys formed of pure Al and Mg should be rolled at about 400° C. Mechanical properties of 2 alloys are given in some detail; one of these, containing 9.5% Mg and 0.2% Si, appears to resist attack remarkably despite its heterogeneity. OWEp (13)

Corrosion Effects in High Pressure Steam-Boilers (Korrosionserscheinungen an Hochdruck-Dampfkesseln) K. Hofer. *Stahl und Eisen,* Vol. 53, Sept. 7, 1933, pages 925-930. Three types of corrosion effects are described: flaky deposits caused by the H-ion concentration of the boiler water; localized pitting produced by too high O_2 content in the feed water; and scaling through the action of steam. These corrosion effects are brought about by strains in and faulty construction of the boiler, through disturbances in the water flow, through scale formation because of unsuitable feed and boiler water treatment, and through foaming. They can be overcome by properly softening the feed water and degassing it to an O_2 content of 0.1 mg./l; by obtaining a sufficient alkalinity with a sodium hydroxide number of over 400; and by bringing up the phosphate content to 20 to 30 mg./l. Cold-working the metal of the boiler should also be avoided. SEp (13)

Preventing Intergranular Corrosion in 18-8 Stainless Steel (Verhütung der Korngrenzenkorrosion bei Stählen mit 18% Cr und 8% Ni) E. Houdremont & P. Schafmeister. *Archiv für das Eisenhüttenwesen,* Vol. 7, Sept. 1933, pages 187-191. Intergranular corrosion in 18-8 stainless steel, due to the deposition of carbides rich in chromium in the grain boundaries, may be reduced by lowering the C content to below 0.07%. Additions of Ti in the proportion of 4 parts Ti to 1 part C to form Ti C instead of carbides rich in chromium, reduced intergranular corrosion in $CuSO_4$—H_2SO_4 solution, after 1000 hrs. heating in the critical temperature range of 500 to 800° C. Curves are given of short time tensile tests at elevated temperatures showing that the sharp drop in elongation and reduction of area which usually occurs in 18-8 on testing in the region of 700 to 800° C., was almost entirely absent with this Ti addition. On heating to 1350° C. all of the TiC can be dissolved in the austenite, to be reprecipitated on cooling in a finely divided but harmless form in the grain boundaries. Annealing ordinary 18-8 stainless at 750° C for 100 hrs., especially after cold working, caused the high chromium carbides to form partly within the grains and also spheroidized them, so that subsequent heating in the critical temperature region caused less harmful grain boundary carbide precipitation. It was also found to be helpful to obtain a two phase austenitic-ferritic structure such as occurred in a 7% Ni — 21.4% Cr steel. SEp (13)

Protective Treatment of Ferrous Pipe. Thomas B. Downer. *Journal American Water Works Association,* Vol. 25, May 1933, pages 605-632. A review in which the author draws the following conclusions. Metal protected from moisture cannot corrode. Chrome-nickel up to 15% alloyed with iron or steel prevents rust in water, air or acids, but this is too expensive for ordinary use. Copper up to 0.2% increases the life of metal sheets 2 to 5 times when exposed to the atmosphere but is of doubtful value under water or in soil. Zinc galvanizing affords little protection underground. Copper service pipes should be used for all small sizes except for inactive waters and well drained soil. Lead paint offers good protection in the atmosphere, but is of little value in water. Carbon paint should never be used as a first coat, but only as a finish coat. Tar dips applied evenly offer good protection for many years but they are not permanent. Heavy centrifugal linings of cement or bitumens are most effective in permanently preventing corrosion. Bitumastic and Talbot linings are very resistant to actively corrosive waters and produce the highest carrying capacity of any pipe. Cement lining is subject to attack by carbon dioxide in the water which may dissolve the calcium carbonate in the cement. Grounding of electric light, power and telephone wires to water pipes should not be permitted. Pipe lines near railway, high tension transmission lines or power houses should be laid with frequent insulating joints. Pipes of different metals used in the same line should be separated with a lead gasket and protected with a coat of asphaltum. Tuberculation is often caused by iron-gathering bacteria which attach to an exposed iron surface. Complete protection of the surface will prevent tuberculation. Cleaning water mains affords only temporary relief from tuberculation, and only accelerates a second formation worse than the first. Alkalinity inhibits corrosion and acidity promotes corrosion. Corrosion of active water may be prevented by the addition of lime to yield a pH value of about 8.0. VVKp (13)

Corrosion of Steel by Gases Containing Traces of Hydrogen Sulphide: Effect of Pressure and Moisture Conditions. John M. Devine, C. J. Wilhelm & Ludwig Schmidt. *United States Bureau of Mines, Technical Paper* 560, 1933, 20 pages. Results are given of a study of corrosion of steel by natural gas containing 12 grams or less of H_2S/100 ft.^{3} of gas. A method for estimating H_2S content of gases and a testing apparatus for determining in the field the comparative corrosiveness of a gas at various pressures are described. Traces of H_2S may cause severe corrosion if O_2 and H_2O are present. Two forms of corrosion have been identified: (a) a less serious form in which no precipitated H_2O is present on the surface of the metal, although the gas may be saturated with H_2O vapor, (b) a severe form in which precipitated H_2O is present on the surface of the metal. Pressure accelerates the reaction, especially in *b*; also, it may precipitate H_2O on the metal and change *a* to *b*. The corrosion threshold concentration of H_2S is lower for *b* than *a*. *a* has the characteristics of chemical attack; *b* appears to be the result of an electro-chemical reaction. The corrosion rate with *b* increases with a decrease in the thickness of the moisture film on the metal, but with continued reduction the reaction finally loses its electrochemical character and becomes *a*. *b* can occur in the absence of H_2S if O_2 is present. In natural gas pipe lines *b* is more important than *a*. Corrosion losses can be reduced by: (1) removal of H_2S (for pressures up to 300 lbs./in.^{2} H_2S should be 0.10 grain or less/100 ft.^{3}), (2) reduction of O_2 content, (3) control of humidity. AHEp (13)

Prolonging the Life of Boiler Tubes. Edward Ingham. *Steam Engineer,* Vol. 2, Aug. 1933, pages 487-488; Sept. 1933, pages 541-543. Composition of tubes, formation of scale, corrosion and erosion are discussed. AHEp (13)

Modern Alloys: Their Application to the Solution of Refinery Problems. Arch L. Foster. *National Petroleum News,* Vol. 24, Nov. 16, 1932, pages 45-48; Dec. 7, 1932, pages 27-32. Summary and review of recent work on alloys for oil refineries. VVKp (13)

Porcelain-Faced Impellers Developed for Turbine Pumps. S. E. Flohr. *Better Enameling,* Vol. 4, Nov. 1933, pages 4-6. Advantages of a deep well turbine pump having porcelain enameled parts include: (1) Increase in efficiency due to lower frictional losses in the pump. (2) Resistance to abrasion as definitely established by test. (3) The porcelain enamel coating acts as an insulation against oxidation and electrolysis and is acid-resisting. (4) Maintenance of higher efficiency over a longer period of time under a given pumping condition. CBJp (13)

Metals and Corrosion in Public Hygiene (Metallwerkstoffe und Korrosion in der öffentlichen Gesundheitspflege) K. Beck. *Oberflächentechnik,* Vol. 10, July 4, 1933, page 156. The importance of resistance of metals against corrosive attack by foodstuffs is discussed. Fe and Al are suitable; Pb, Hg, As, Sb and, to a certain extent, Cd must be avoided; Cu, Zn, Sn, Cr are not objectionable from the point of view of health when used as protective coating. Hap (13)

Rustproof Metal Coatings (Ueber rostsichere Metalüberzüge) W. Borchert. *Oberflächentechnik,* Vol. 10, Apr. 4, 1933, pages 85-86. Rustproof coatings can be formed only by nobler metals than Fe, i.e. Cu, Ni, Cr; these are the more efficient if a base of Zn or Cd is applied first. Corrosion tests in salt spray have shown, however, that a Ni-Cr layer on Cd did not adhere very firmly, it came off and the Cd base disappeared due to formation of local elements. This can be avoided by first applying a dense Cu deposit which is carefully polished to close all pores; then Ni is deposited. Several layers of similarly acting metals give the best results, but most important is careful handling. Hap (13)

Safety at Petroleum Cracking Plants. R. L. Marek. *United States Bureau of Mines, Technical Paper* 551, 1933, 92 pages. The influence of temperature and corrosion on cracking equipment, the selection of proper metals for various equipment, the prevention of corrosion, etc. are discussed. AHEp (13)

Results of Kinetic Investigations of Passivity Phenomena (Ueber die Ergebnisse der kinetischen Untersuchungen der Passivitätserscheinungen) W. J. Mueller. *Oberflächentechnik,* Vol. 10, June 6, 1933, page 132; *Angewandte Chemie,* Vol. 46, Apr. 8, 1933, pages 197-198. Passivity of a metal is defined as that behavior which it shows chemically or as anode when it dissolves not at all or only very little as compared with what it should do under the normal behavior (activity). The kinetic laws of the relation between time and current during electrolysis were derived and experimentally confirmed. The formation of a protecting layer is explained. This layer is never quite complete or dense but the formation stops at a certain size of pores, about 10^{-3}-10^{-4} cm. Every anodic passivity consists primarily in covering the free surface of the metal with products of electrolysis deposited on the surface, and it makes no difference whether the metal surface was covered before entirely or partly with any other (oxide, hydroxide) layer. Mathematical equations for formation and depth of layer are given. Ha (13)

Recent Experiments on the Rusting of Iron on the Basis of Modern Passivity Research (Neuere Versuche über das Rosten von Eisen auf der Grundlage der modernen Passivitätsforschung) W. J. Mueller. *Oberflächentechnik,* Vol. 10, July 4, 1933, pages 155-156. Various theories on passivation of Fe and different forms of corrosion are discussed and certain discrepancies described. Theory of Evans is found satisfactory with respect to qualitative phenomena but not in explaining the mechanism of corrosion. Recent experiments show the importance of the ratio of the free area to the oxide-covered area of a surface. Corrosion passivity occurs when metal is covered with an oxide layer; the layer grows in depth but not in extension. Measurement of salt formation is a means to detect the width of the pores and the growth of the protecting oxide film. The crystallization is an indication of the amount of current which has to be sent through in order to obtain corrosion passivity. Ha (13)

Corrosion studies on Hydronalium (Korrosionsversuche mit Hydronalium) P. Brenner. *Zeitschrift für Metallkunde,* Vol. 25, Oct. 1933, pages 252-258. The behavior of Hydronalium (Al + 7-8% Mg) in a 3% aqueous solution of NaCl and in sea water was studied in comparison with duralumin and pure Al (99.5% Al), by inspection of the surface and by measurement of tensile strength and elongation upon progressive corrosion. The tensile strength and elongation of Hydronalium in both the hard and soft states are only very slightly attacked by the 3% NaCl solution after six months, whereas both decrease markedly for duralumin and pure Al. Similar results were found for corrosion in sea water. Although the present price of Hydronalium is high, the superior corrosion resistance and the ease of welding promise wide application. Additional data are given in a lengthy discussion. RFM (13)

Corrosion of Cast Iron. S. Spray. *Mechanical World & Engineering Record,* Vol. 93, Mar. 10, 1933, page 241. Discussion of experiments on the relative corrosion in dilute H_2SO_4 of different cast irons, in which the graphitic carbon was present in coarse and fine form respectively. Kz (13)

Combating the Corrosion Problem with Lubricated Valves. George F. Scherer. *Industrial & Engineering Chemistry,* Vol. 23, Sept. 1931, pages 986-989. See *Metals & Alloys,* Vol. 4, Aug. 1933, page MA 246. MEH (13)

Cast Iron of High Resistivity against Chemical Attack (Das Gusseisen für chemisch beanspruchte Teile) L. Schmid. *Zeitschrift für die gesamte Giessereipraxis,* Vol. 54, July 23, 1933, pages 298-300. Author first discusses resistance of cast Fe against chemical attack in relation to composition and structure, behavior of carbides, graphite, silicides, phosphides and sulphides against alkalies and acids. Average chemical composition of such cast Fe and melting charges are tabulated. Alloyed cast irons are particularly referred to with special reference to Si-cast Fe resisting strong and hot acids and irons resisting the attack of molten and diluted alkalies. GN (13)

Some Remarks on Experimental Characteristics of the Solution of Metals by Chemical Reagents (Remarques sur la caracterisation expérimentale de la dissolution des métaux par les réactifs chimiques.) A. Portevin & P. Bastien. *Génie Civil,* Vol. 100, June 1932, pages 559-562. The possible types of corrosion attack described before (A. Portevin, *Revue de Métallurgie,* Vol. 26, 1929, pages 606-635) are summarized. The loss of weight almost never can be taken as a definite criterion, particularly when the rate of the change of the corroding medium is not known. Using Thyssen and Bourdouxhe apparatus (*Revue Universelle des Mines,* 7th series, Vol. 19, July 1928, page 63) the influence of the rate of change of corroding solution on corrosion of Mg-Al-Cu alloys was determined. With 1% HCl solution the loss of weight curve becomes a straight line when the solution circulates 4.6 meters per minute. At this circulation speed 1% HCl attack on Mg-Al alloys decreases to 9% Al (saturated solid solution) and then increases. In a decinormal solution of citric acid the formation of a superficial film decreases corrosion. JDG (13)

Modern Short-period Rust Preventers. P. Mabb. *Machinery,* London, Vol. 42, June 1, 1933, pages 249-252. Discussion of mineral oils as rust preventers and their advantages and limitations. They possess the advantages of chemical inertness, homogeneity, stability, non-volatility, ease of application, but they suffer from relatively poor film strength and some tend to "ball-up." Hot humidity test is discussed to evaluate the relative merits of various types of preventers. Results of tests are given in a table. Characteristics of petroleum oils and jellies are gathered in two other tables. The use of varnishes is dealt with. Lanolin is called the best rust preventer and the various advantages are discussed. Characteristics are presented in a table. Discussion of the application of rust preventers. Kz (13)

Surface Protection and Coloring of Aluminum. H. KURREIN. *Metal Industry,* London, Vol. 43, July 28, 1933, pages 75-78. See "Protective Coatings, Rust Protection and Coloring of Aluminum," *Metals & Alloys,* Vol. 2, Mar. 1931, page 64. Ha (13)

Protection of Boilers from Corrosion (La Protection des Chaudieres contre les Corrosions) J. LAUER. *Revue Technique Luxembourgeoise,* Vol. 25, May-June 1933, pages 71-74. The theories of Evans, Freundlich and others on the causes of corrosion in boiler plates are briefly discussed. The collection of slimy deposits should be avoided and frequent cleaning is recommended. A boiler cleaning apparatus is described. Ha (13)

Magnesium Alloy Protection by Selenium and Other Coating Processes. Part II. G. D. BENGOUGH & L. WHITBY. *Institute of Metals,* Advance Copy No. 639, Sept. 1933, 4 pages; *Metal Industry,* London, Vol. 43, Sept. 22, 1933, page 295. Sheet samples protected by different coatings, including paint over selenium, were immersed in sea water or sprayed with sea water. Even in cases where the alloy appeared to be in good shape the material had a low elongation. Neither loss in weight nor appearance offered a criterion for resistance to corrosion. JLG + Ha (13)

Economics of Pipe Wall Thickness in Gas Distribution. NORMAN L. HOFF. *Gas Age Record,* Vol. 71, June 3, 1933, pages 573-575. Paper before the Spring Conference of the Technical Section, Pacific Coast Gas Association. After going into extensive mathematics to determine the allowable cost of protecting pipe against soil corrosion based on the assumption that the life of two bare pipes are proportional to the square roots of their wall thicknesses, the author decides that the use of his equations is about 90% good judgment and 10% simple algebra. VVK (13)

Corrosion and Its Prevention (Naagot om Korrosion och Korrosionsskydd) GILLIS EM. HUSS. *Tekniska Föreningen i Finland Förhandlingar,* Vol. 53, Nov. 1933, pages 275-286. Discusses the present theories of corrosion and gives a review of the most important methods for combating corrosion, including galvanizing, Sherardizing, calorizing, Parkerizing, electroplating, acid-proof paints, use of corrosion resistant metals and alloys, and the addition of small quantities of foreign metals to increase corrosion resistance. BHS (13)

Modern Light Alloys with Particular Reference to Corrosion. L. AITCHISON. *Metal Industry,* London, Vol. 42, Mar. 24, 1933, pages 323-324, 330. A review of alloys of Al, the increase of mechanical properties of Al alloys and heat treatment for further increase, stress conditions leading to corrosion and general means of protection by coating. In summary, the pure metal and those Mg-containing alloys that do not require heat treatment are usually the best to withstand corrosion. Of the heat-treated alloys the ones which are age-hardened at room temperature are the most resistant. The worst are those which have had their maximum strength greatly increased by precipitation heat-treatment, the great increase having been obtained at the expense of resistance to corrosion. Ha (13)

Corrosion and Protection of Metals (La corrosion et la protection des métaux). U. R. EVANS. *Revue de Métallurgie,* Vol. 30, Nov. 1933, pages 502-508. A general survey of the subject giving 36 references. JDG (13)

Results of Corrosion Research and Recent Methods of Testing Materials for Resistance against Corrosion and Erosion (Ergebnisse der Korrosionsforschung und neuere Verfahren zur Prüfung von Werkstoffen auf Beständigkeit gegen Korrosion und Erosion) W. DENECKE. *Die Giesserei,* Vol. 20, Mar. 3, 1933, pages 89-93. Corrosion is defined as an involuntary destruction of a metallic substance by chemical or electrochemical action of non-metallic substances whereby the attacked substance loses its metallic character; erosion is a wearing effect due to mechanical effects. The electrochemical theory of corrosion is explained and testing methods and apparatus are described and reviewed as to their practical applicability. 35 references. Ha (13)

Erosion of Low Pressure Moving Blades (Erosionen an Überdruck-Laufschaufeln) B. HAKE. *Elektrizitätswirtschaft,* Vol. 32, Apr. 15, 1933, pages 144-146. The moving blades of 2 condensation turbines of 24,000 and 30,000 kw exhibited excessive erosion defects the course and extent of which are fully reported. The characteristic form of the erosion defects is influenced by the construction of the turbine housing. The investigation revealed that the high grade V5M Krupp steel (no analysis) did not prove to be superior to an ordinary 5% Ni steel. WH (13)

A Study of the Passivity of Iron and Aluminum. W. H. CONE & H. V. TARTAR. *Journal American Chemical Society.* Vol. 56, Jan. 1934, pages 48-52. The presence of phosphates (except small quantities with Al) and of sulphates accelerates the rate of dissolution of Fe and Al in nitric acid. The presence of phosphate or sulphate modifies the electrical potential difference of passive Fe against nitric acid, making the metal more electronegative with respect to the solution. There is no abrupt change with these metals in nitric acid, between the active and passive states. The effectiveness of anions accelerating dissolution is attributed to the adsorption of these ions at the oxygen film-solution interface. Air-exposed Fe is passive in concentrated chromic acid solution. The passivity may be destroyed by reduced pressure, a H atmosphere, or by wetting with solutions of electrolytes of sufficient concentration. Dilute nitric acid can be made inactive toward air-exposed Fe by the addition of Ag nitrate. MEH (13)

Corrosion-fatigue Characteristics of Aluminum Specimens Consisting of Two Crystals. H. J. GOUGH & D. G. SOPWITH. *Institute of Metals, Advance Copy* No. 641, Sept. 1933, 16 pages. A specimen consisting of 2 crystals of Al was subjected to alternating torsional stresses in a stream of tap water. The orientations of the 2 crystals were determined by X-ray methods. The specimen was examined at intervals during the test. The boundary was not attacked by the corrosive medium, neither did it influence in any visible manner the method of failure of the specimen, which took place primarily by the formation of cracks in areas undergoing heavy plastic deformation. On the surface of the specimen these cracks were generally parallel to the operative slip planes. In several cases they had their origin at holes situated in the most highly stressed regions; of the origin of these holes no definite evidence was found. While general attack in the form of oxide film and pitting occurred throughout the duration of the test (about 6 weeks) this apparently did not contribute to the failure. JLG (13)

Chemical and Electrochemical Corrosion, in Particular of Copper (Uber chemische und elektrochemische Korrosion, insbesondere am Kupfer) CASSEL. *Oberflächentechnik,* Vol. 10, June 6, 1933, pages 132-133. Dry corrosion is usually a purely chemical, while wet corrosion can be considered an electrochemical process. Recent investigations are reviewed, the depolarization theory seems to explain the phenomenon in Cu best, that is, that the metal is ennobled on those places of its surface where O can get at it and form a protective film. The conductivity of such protective films on metals was investigated in order to find relations with the rectifying effect (valve effect) of some films. It seems that the film is sometimes a semiconductor which causes the interruption of current passing through it. In warm water installations in which the boiler was of iron, the heating coils of Cu were more rapidly subject to destruction by corrosion than where the whole installation was made of Cu; sometimes the water is the reason when it does not contain those constituents which lead to formation of a protective film on Cu. Ha (13)

Influence of a Magnetic Field on Corrosion of Iron by Salts of Noble Metals (Influence du champ magnétique sur la corrosion du fer par les sels de métaux nobles) H. FORESTIER & M. HAURY. *Comptes Rendus,* Vol. 197, July 3, 1933, pages 54-56. Continuing their studies of the effects of magnetic fields on the solubility of Fe in various solutions, the authors have experimented with halogen salts of metals electropositive to copper. In general the rate of solution increases with the intensity of magnetization. With increased concentration of a salt the solubility of Fe first increases then decreases to a limiting value at high concentration of the salt. OWE (13)

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APPLICATIONS OF METALS & ALLOYS (14)

Air Way (La Voie Aérienne) E. Marcotte. *Arts-et-Métiers,* Vol. 85, Nov. 1932, pages 411-423. General survey of all questions on which is based modern aircraft technique. One part of the article dealing with materials used in airplane construction and metallurgy gives particulars on followings points: if lightness only is considered order of materials for "equal toughness" is, (1) alloy steel, (2) elektron and Mg alloys, (3) duralumin and Al alloys, (4) wood and semi-hard steels, (5) mild steel. For rigidity wood and duralumin have advantages. Alloy steel allows fabricating members in suitable stream line form. Cd plating is of interest for protection of metallic members against corrosion but stainless steel of high toughness is more and more largely used in this connection. Electric welding allows decrease of weight through avoidance of rivets. Reinforced bakelite has promise for early use. In relation to metallurgy chief points to be noted are: Temper brittleness of alloy steels (Kruppkrankheit) can thoroughly be cured through Mo additions. ATV alloy and Cr-Si represent an important progress as valve materials. Nitrogen hardening results in a great improvement of wearing parts such as cylinder linings. Al-clad duralumin is much less corrodible than duralumin. Beryllium and beryllium alloys would find many uses in aircraft construction if they were cheaper. FRp (14)

Metallurgy in Connection with Shipbuilding and Marine Engineering. F. C. Lea. *Metal Industry,* London, Vol. 43, Nov. 10, 1933, pages 461-463. **Recent Metallurgical Developments and their Significance for Shipbuilding and Marine Engineering.** *Metallurgia,* Vol. 9, Nov. 1933, pages 21-24. Metals and alloys used in shipbuilding are discussed; high elastic limit, heat-treatment, corrosion resistance are of greatest importance. A steel recommended has the composition 0.46 C, 1.20 Si, 1.09 Mn, 26.5 Ni, 14.0 Cr, 3.59 W, 0.028 S, 0.026 P; limiting creep stresses are 11, 6, 2 tons/sq. in. at 600, 700, 800° C. resp. A cast steel for turbine valves of 0.3-0.45 C, 0.2-0.3 Si, 0.6-0.8 Mn, 0.05 S, 0.005 P, 0.25 Ni, 1.0-1.5 Cr, 0.8-1.0 Mo, can be used for temperatures up to 1000° F. and has a limiting creep stress of over 5 tons/in.^{2} Cu alloys, especially monel metals, the various Al alloys, effects of Mg and magnetic alloys are discussed and fields of application indicated. JLG + Hap (14)

What Beer Means to Our Metal Business. George S. Herrick. *Iron Age,* Vol. 131, Mar. 23, 1933, pages 461-463, 482. Outlines some of the probabilities of consumption of metals in the United States with the return of beer. Predictions are made on the basis of European practice where brewing has not been interrupted. Discusses the use of such metals and alloys as: Cu, Al and Al alloys, Ni and Ni alloy, Cr and Cr alloys; etc., and their advantages in brewing. VSPp (14)

Development of New Equipment Materials for Chemical Manufacture. W. R. Huey. *Industrial & Engineering Chemistry,* Vol. 26, Jan. 1934, pages 10-16. A review of recent equipment materials including metals and alloys. Among the materials are mentioned alloy-clad steel, Be alloys, armored silica, Durichlor, 5% Cr steel, stainless alloys, and various nonmetallic coatings on metal. MEH (14)

Metals in Aircraft Construction. Robert Jones. *Heat Treating & Forging,* Vol. 19, Oct. 1933, pages 35-37. Describes processes employed by the Boeing Airplane Company in the fabrication of steel and Al aircraft parts. MS (14)

Materials for Machines and Apparatus for Industries Using Acetylcellulose (Bau- und Werkstoffe für die Maschinen und Apparate der Azetylzellulose verarbeitenden Industrie) Fritz Ohl. *Korrosion, Supplement to Chemische Apparatur,* Vol. 8, July 25, 1933, pages 25-26. The materials to be used for machinery equipment for making artificial silk, films, pressed articles, etc., with acetylcellulose must be resistant to the solvents used and also mechanically strong in the case of presses, stirrers, mixers, etc. Zn, Cu, Al are used for tanks and containers; tinned bronze, Cr-Ni steels and other alloy steels in apparatus demanding strength. Contact with free Fe parts must be avoided. Ha (14)

Progress of Metallic Construction in Aviation (Les progrès de la construction métallique dans l'aviation) J. Bally. *Revue de l'Aluminium et de ses applications,* Vol. 10, July-Aug. 1933, pages 2149-2156. A review of the use of metals for airplanes of European makes. AH (14)

Metals in Art (Les metaux dans l'art) Louis Delville. *Aciers Spéciaux, Métaux et Alliages,* Vol. 8, July 1933, pages 197-202, 231. Tin, silver and bronzes found extensive use in ornamental and artistic objects. Wrought duralumin along with stainless steel is now used in modern furniture, while forged Fe and Cu are used in decorating portals. GTM (14)

Present-Day Questions in the Construction of Machine Elements (Gegenwartsfragen im Bau von Maschinenteilen) E. Heidenbroek. *Zeitschrift Verein deutscher Ingenieure,* Vol. 77, Oct. 28, 1933, pages 1165-1171. Progress made in durability and permanence of shape, efficiency, consideration of appearance of elements for construction of machinery is reviewed; highest efficiency is not necessarily that of technical performance but that from the point of view of economy. Welded joints, rivets, gears, high-grade screws and bolts, calculations of strength, safety factors, are treated. 16 references. Ha (14)

Metals in the Electrical Industries. The Alloys of Nickel and Chromium with Iron. C. J. Smithells. *Iron & Steel Industry & British Foundryman,* Vol. 6, June 1933, pages 327-330. The magnetic properties of Ni-Fe alloys with more than 50% Ni, and the low thermal expansion coefficients of the 36% Ni alloy make them applicable for various electrical uses. The powdered Fe-Ni alloys are useful for transformer cores. Alloys of Ni-Cr-Fe, some of which contain 3-10% Mo, have good properties at elevated temperatures, and therefore they find specific application for high temperature purposes. CHL (14)

Chemical Engineering and the Aircraft Industry. H. T. Tizard. *Transactions Institution of Chemical Engineers,* Vol. 10, 1932, pages 87-94. General. AHE (14)

Precautions to be Observed in the Design of Sand-Cast and Machined Components. A. F. C. Pollard. *Journal of Scientific Instruments,* Vol. 10, Sept. 1933, pages 265-272. Points to be observed in the design of machined castings of cast iron, brass and Al base alloys. RAW (14)

Metals for Dairy Equipment. *Oxy-Acetylene Tips,* Vol. 12, Aug. 1933, pages 185-186. Iron and steel are never used in direct contact with milk. Coatings of Sn, Zn or Cr are good as long as they are continuous. The austenitic, annealed 18-8 Cr-Ni stainless steel is used at present with greatest success for dairy equipment. Ha (14)

Air Turbines. J. F. Romer. *Machinery,* London, Vol. 42, Sept. 28, 1933, pages 757-759. Discussion of principles governing the design and application of various types. As the wheels run at very high speeds, and centrifugal forces are great, it is important to use a metal having a high ratio of strength to weight, the centrifugal stress being directly proportional to the specific gravity. The following table gives ratios for various materials:

		Sp. Gravity	Ratio
Mild steel,	30 tons tensile	7.8	3.85
Ni-Cr steel,	70 tons tensile	8.6	8.14
Hard-rolled brass,	20 tons tensile	8.5	2.37
Duralumin "B" hard,	27 tons tensile	2.8	9.64
Bakelized cloth,	8 tons tensile	1.4	5.72

Duralumin is superior even to the Ni-Cr steel and is the best material to employ. As the expansion of the air causes it to become very cold, an Al alloy will not soften and lose strength as it would with steam. Brass is the poorest material but is used for the wheels of turbine-driven gyroscopic instruments for aircraft, principally because it is necessary to have considerable weight to obtain the gyroscopic effect, and because the blades are easily machined. Kz (14)

Non-Ferrous (14a)

G. L. CRAIG, SECTION EDITOR

Selection of Light Metals for Automobile Construction (Die Wahl von Leichtmetallen für den Kraftfahrbau) E. Eichwald. *Automobiltechnische Zeitschrift,* Vol. 36, Oct. 25, 1933, pages 501-506. A list of 60 Al and Mg alloys, their trade names, mechanical properties, shapes in which available, and particular parts for which suitable, and names of manufacturers is given. A special table contains the compositions of some of them, and the points to be observed in their application; the economical advantages are enumerated. 56 references. Hap (14a)

Application of Metal Sheets for Surveying Plans. R. McAdam, John S. Reid & J. K. Templeton. *Iron & Coal Trades Review,* Vol. 127, July 21, 1933, page 97. Ordinary bright Al sheets have proved to be very suitable to replace paper sheets for making survey maps. To reduce eye-strain by glare and to make the sheets more receptive for pencil marks the sheets are treated with a caustic to give them a matte surface. Metal sheets are particularly advantageous for fundamental plans as they never alter in size as does paper. Hap (14a)

The Design of Die Castings. F. A. W. Livermore. *Metal Industry,* London, Vol. 42, Feb. 24, 1933, pages 217-218. The principal considerations governing the design of the dies are discussed; sharp corners are to be avoided in order to prevent excessive stresses and cracks in these places; thin sections should be properly reinforced by ribs. Gating and venting must be properly dimensioned and located, no air pockets must develop. Engravings should be "raised" on the casting, that is, "depressed" in the die. The ejection mechanism must be of proper design not to distort the casting. The dies are preferably made of specially heat treated alloy steels, best of Cr-V steel. To ensure long life and continued accuracy of the product, the opening and closing of the dies and the ejection of the casting should be mechanically operated and controlled directly by the mechanism of the machine. Hap (14a)

Faucets and Water Valves of Copper-Containing Metals (La Robinetterie; l'Usage des Métaux Cuivreux dans cette Industrie) A. Chaplet. *Cuivre et Laiton,* Vol. 6, Feb. 15, 1933, pages 57-68; Mar. 15, 1933, pages 111-118. The different constructions of valves, faucets and fittings for water supply both in domestic installations and in industrial plants are described and illustrated in detail. Hap (14a)

Material for Mines (Matériel des mines) J. Bally. *Revue de l'Aluminium et de ses applications,* Vol. 9, Sept.-Oct. 1932, pages 1847-1860. Studies critically the use of Al and its alloys in mines from a standpoint of economy. Concludes that every mine will be justified in considering the use of light alloys for hoisting equipment. AHp (14a)

Aluminum in the equipment of varnish-making factories (L'Alluminio nell attrezzatura delle fabbriche di vernici) C. Bianchi. *Alluminio,* Vol. 2, Mar.-Apr. 1933, pages 90-97. Aluminum can be used as a protective lining in much of the equipment used in varnish-making plants. Prolonged contact with glycerine does not affect Al. Al is also unaffected by alcohols, ketones, acetates, cyclic compounds, etc., used in varnish-making, including solvents used for dissolving the synthetic resins. Al is preferable to iron and steel in handling these solvents, because of the reduced danger from sparks by accidental striking, etc. Illustrations of equipment are shown. AWCp (14a)

Manufacture and Use of Powdered Metals. Charles Hardy. *American Metal Market,* Vol. 39, Aug. 3, 1932, pages 2, 5. See *Metals & Alloys,* Vol. 4, July 1933, page MA 218. DTR (14a)

The Advance of Light Metals. (Der Aufstieg des Leichtmetalls.) William Guertler. *Umschau in Wissenschaft und Technik,* Vol. 37, June 24, 1933, pages 495-496. In spite of the low strength per unit volume a higher strength value/weight is secured by Al, Mg and their alloys as shown by the following table:

	Steel	Special Steels	Al	Duralumin	Elektron (Mg Alloy)
Normal strength values in kg./sq. mm..	100	150	20	50	40
Required wire cross section for 100 kg. load in sq. mm.	1	0.66	5	2	2.5
Ratio of wire weights at equal wire length referred to steel = 1	1	0.66	1.66	0.66	0.5

Mg alloys rate first but their atmospheric stability is inferior to Al. The advantageous use of Al due to its favorable conductivity as a competitor for Cu is considered. The production of light metals reveals the future trend:

Year:	1885	1895	1905	1915	1925	1930
Tons:	13	2000	11,500	82,000	185,000	250,000

EF (14a)

Press Construction and Selection. S. D. Brootzkoos. *Metal Stampings,* Vol. 6, Jan. 1933, pages 7-14, 35. Includes discussion of materials used in construction of press frames, these being cast-iron, "semi-steel," cast-steel, and welded steel plates. Gives composition of two phosphor bronzes for press bearings and composition of SAE 1045, "Ford EEE," and SAE 3140 steels which are used for press crank-shafts. MS (14a)

Selenium in Canada. (Selen in Kanada.) *Die Metallbörse,* Vol. 22, Oct. 26, 1932, pages 1374-1375. Refers to metallurgical production of Se by Ontario Refining Co, Ltd, and reviews present commercial use EF (14a)

Welded Aluminum Tanks. W. E. Archer. *Welding Engineer,* Vol. 17, Nov. 1932, pages 30-31. Design and manufacture of Al-tanks of 11 ft. in diameter and 12 ft. height are described. They were chosen instead of steel tanks in order to avoid discoloration of liquids in soap manufacture Ha (14a)

Special Ludlow Metal Formula. *Printing Equipment Engineer,* Vol. 45, Mar. 1933, page 18. Practical tests during the previous year showed that a metal of the composition 6.5% Sn, 11.5% Sb, balance Pb, gave superior results over the use of standard line-casting machine metal Kz (14a)

Handling of Distilled Water in Aluminum. H. V. Churchill. *Industrial & Engineering Chemistry, Analytical Edition,* Vol. 5, July 15, 1933, pages 264-266. The usefulness of Al for handling distilled water is shown by the fact that it does not seriously contaminate distilled water, it is available in a variety of wrought and cast forms, it is easy to erect and assemble, and the system may be easily disassembled in case such procedure is desirable. MEH (14a)

New Developments in Hard Carbide Materials. Gregory Comstock. *Machinery,* Vol. 38, June 1932, pages 735-737. Brief review of carbide tools. Deals with tungsten and tantalum carbide but presents practically nothing new and little technical information. RHP (14a)

Application of the Principles of Light Metal Construction to Vehicle Design. (Anwendung der Grundsätze des Leichtbaues auf den Fahrzeugbau.) H. Bieck & H. Grosseck. *Verkehrstechnik,* Vol. 49, Dec. 5, 1932, pages 660-661. Discussion on a previous paper of Grosseck (*Verkehrstechnik,* Vol. 49, Sept. 24, 1932, pages 535-541.) mainly pertaining to the question whether or not to abandon a solid under-carriage construction. The differing conditions in aircraft construction are touched upon. WH (14a)

Extra-light Metallic Structures. (La construction métallique en alliage léger.) J. Bally. *Revue de l'Aluminium et de ses applications,* Vol. 9, Sept.-Oct. 1932, pages 1861-1866. A description of a type of "hollow structure" for airplane construction made with light alloys having good mechanical properties. AH (14a)

Brewery Material—Fermentation and Storage Tanks. (Le matériel de brasserie—cuves de fermentation, tanks de garde.) J. Bally. *Revue de l'Aluminium et de ses applications,* Vol. 9, May-June 1932, pages 1741-1752. Critical survey of the use of Al and other materials. AH (14a)

Powdered Metals. *Product Engineering,* Vol. 4, Jan. 1933, page 9. Brief review of uses of metal powders, especially of Cu, Fe, Ni, Cr, Sn, Zn, Ag or Mo which are obtained by electrolytic processes and then compressed under dies at 2 to 250 tons/in.^{2} and sintered to weld or alloy the particles. Tungsten-carbide tools, carbon brushes, welding electrodes, etc. are produced in this manner. Ha (14a)

Tin and the Railways. *Tin,* June 1933, pages 14-15. The requirements of tin with changing conditions in operation of railways are discussed. The trend from electrification towards Diesel-electric drive would mean an increased consumption of Sn on account of more bearings in dynamos and motors being required. Ha (14a)

The Simple Miracle of the Tin Can. *Tin,* Nov. 1932, pages 1-5. Manufacture of the tin can is described from the sheet to the finished product, with particular reference to the methods employed by an English factory. Ha (14a)

New Alloys and Improved Technique Extend Use of Zinc Die Castings. *Steel,* Vol. 91, Dec. 5, 1932, pages 21-23. Zn and alloy Zn die castings are finding wider use in automobile carburetors, fuel pumps and windshield wipers and as gears, levers, etc., in check protectors, moving picture projectors, textile machinery, bench lathes, etc. Recently developed alloys show increased impact resistance and tensile strength. JN (14a)

Metals for Large Tablets. *Metal Industry,* London, Vol. 42, May 12, 1933, pages 489-490. Methods of producing large metal (memorial) tablets are described. Uses and limitations of Cu and its alloys, Al and its alloys and advantages of deposited metal are described Ha (14a)

Aluminum Alloys as Piston Materials (Aluminium legierungen als Kolbenwerkstoffe) R. Sterner-Rainer. *Die Giesserei,* Vol. 20, Mar. 17, 1933, page 112; *Schriften der Hessischen Hochschulen,* 1933; No. 2, pages 20-25. The good qualities of Al alloys, especially with Cu-additions, for use as piston material are due to the presence of hard compounds embedded in a soft mass; the addition of Cu increases hardness and strength after a suitable heat-treatment. The greater expansion coefficient can be balanced by constructive arrangements, and by use of a suitable cylinder material, e.g. Ni-containing cast iron. The particular characteristics of Al-Si and Al-Mg alloys are briefly discussed. GN + Ha (14a)

Japan Adopts Pure Nickel Coinage. James A. Rabbitt. *Far Eastern Review,* Vol. 29, Apr. 1933, pages 173-177. The evolution of Japanese Ni coinage is historically traced, a flow chart of manufacturing Ni coinage is given and a table presents a list of pure Ni coins adopted by various countries. WH (14a)

Developments in Aluminum Alloys in Relation to Economics in Aircraft Construction. C. F. Nagel & G. O. Hoglund. *Transactions American Society of Mechanical Engineers,* Vol. 55, Aeronautical Engineering, Apr.-June 1933, pages 75-78. See *Metals & Alloys,* Vol. 4, Apr. 1933, page MA 115. Ha (14a)

Tin in Shipbuilding. *Tin,* May 1933, pages 18-19. The use of Sn and Sn alloys in modern liners is discussed; considerable quantities are used amounting to about 17 tons in a liner of 20,000 to 30,000 tons. Ha (14a)

The Necessity for Tin. *Tin,* Sept. 1933, pages 5-6. The annual report of the Chief Medical Officer (Great Britain) points out the necessity for using tin instead of lead lining in many containers for foods and beverages as often cases of poisoning due to Pb have occurred. Ha (14a)

The First Copper House. *Sheet Metal Worker,* Vol. 24, Sept. 1933, page 291. Brief description of construction. Ha (14a)

Lead on Prize-Winning House. *Sheet Metal Worker,* Vol. 24, Sept. 1933, page 293. Roof, gutters, leaders, are made of Pb; constructive details are briefly described. Ha (14a)

Nickel or Aluminum Bronze? (Nickel ou Bronze d'Aluminium?) *L'Usine,* Vol. 42, Apr. 7, 1933, page 23. The pros and cons of these 2 metals for the coining of French money are discussed. Final decision in favor of aluminum bronze, first because of the difficulty of working pure Ni due to its brittleness, and secondly because it could be easily counterfeited. Ha (14a)

The Heart of the Electric Lamp. *South African Electrical Review & Engineer,* Vol. 24, Aug. 1933, page 45. Coiled tungsten filaments are made by winding the tungsten wire round a steel wire which is subsequently dissolved leaving the coil intact. The filament is heat treated to make its internal structure permanent, insuring filaments of uniform life. RRS (14a)

Iron Nickel Alloys for Bimetallic Thermostat Bars (L'emploi des ferronickels dans la construction des bilames) *Revue du Nickel,* Vol. 4, July, 1933, pages 87-90. Invar and other iron nickel alloys with nickel content ranging from 24% to 50% are used for thermostats, thermal relays and fire alarms. AH (14a)

Bicycles of Duralumin (Les bicyclettes en duralumin) G. Py. *Revue de l'Aluminium et de ses applications,* Vol. 10, July-Aug. 1933, pages 2157-2164. The replacement of steel by duralumin for bicycles results in a decrease in weight of 35%. Besides excellent mechanical properties duralumin is recommended for its tarnish resistance and elastic properties. AH (14a)

Aluminum in Electric Power Plants (L'Alluminio nelle Centrali Elettriche) M. Preiswerk. *Alluminio,* Vol. 2, No. 4, July-Aug. 1933, pages 209-215. Although the conductivity of Al is lower than that of copper, its sp.gr. is so low that an Al conductor weighs only one-half that of an equivalent copper conductor. The greater surface also provides 12% greater cooling. Thus, in case of short circuits, Al heats up to a less degree than copper. Photographs of existing installations are shown. AWC (14a)

Effect of Vibrations of Small Amplitude and High Frequency on Electrical Conductors (Le vibrazioni di piccola ampiezza e grande frequenza sui condutori delle linee elettriche di trasporto) C. Pramaggiore. *Alluminio,* Vol. 2, Sept.-Oct 1933, pages 251-284. Review of work done in finding the cause and remedy for breakage of electric wires due to vibrations set up by the wind, and like causes. It is believed that the reason there has been less trouble from this source in Italy, is because lines are set up in Italy with strength factor of safety of 3 or more, whereas, in many countries they are loaded up to 60-70% of the elastic limit of the metal employed. Various theories are discussed, with a mathematical analysis of the vibrations set up with varying pressure. Photographs of representative installations are shown. 81 references. AWC (14a)

Turbadium. *Polytechnisch Weekblad,* Vol. 27, Sept. 7, 1933, page 575. For high-speed propellers of the recent Atlantic super-liners an alloy is employed containing 50% Cu, 45% Zn, 2.0-2.5% Ni, 0.8-1.0% Fe, 0.5% Sn, 1.5-2.0% Mn. T.S. = 63 kg./mm.^{2}. WH (14a)

Semi-Finished Copper Products for Electrical Engineering (Halbzeug aus Kupfer für Elektrotechnik) *Die Metallbörse,* Vol. 23, Aug. 23, 1933, pages 1086-1088. The new DIN (German standards) proposals for standardization of Cu semi-finished products including wires, bars of various profiles, tubes, sheets, and strips, their dimensions and principal physical properties are listed. EF (14a)

America's Aeronautical Industry. *Aviation,* Vol. 32, Sept. 1933, pages 257-266. Survey of the American aviation industry. Strength is the goal in airplane design. Some countries accept aluminum alloy construction, others have welded steel, and still others have steel strips assembled by riveting. American aircraft industry has been fortunate in that it has been free from design prejudices, and in addition has kept plugging ahead in design research. Liberality of its research efforts, open-minded governmental supervision and similar industry, in general, have given all kinds of materials and designs a fair trial. Development of steel-backed bearings has been a major factor in increasing the time between overhauls and reducing the number of engine failures. DTR (14a)

Light Alloys Cut Weight of New Leyland High Speed Diesel. *Automotive Industries,* Vol. 69, July 15, 1933, pages 69-70. Several new ideas are embodied in the design of a commercial Diesel engine as developed by the British firm of Leyland Motors, Ltd. Low weight is made possible by the extensive use of light alloys. Pistons are of Y alloy, connecting rods of the so-called R. R.-56 Al alloy. The crankcase and sump are Mg alloy castings. The crank and piston pins bear directly in Al rods. All these particulars account for the low specific weight of the engine. DTR (14a)

Stress-Strain Studies of Transmission Line Conductors. G. W. Stickley. *Transactions American Institute of Electrical Engineers,* Vol. 51, Dec. 1932, pages 1052-1058. Cable-testing equipment for stress-strain testing is described to ascertain the mechanical behavior of bare electrical line conductors. Cables not previously stressed are not elastic throughout the range of stress to which they are subjected in service. The elastic limit is usually considerably less than the assumed maximum loading condition and the actual extensions of the cable at low stresses are greater than those resulting from the elasticity of the solid material. Application of stress to a cable increases its actual modulus of elasticity which, even after being increased by stressing is less than that of a simple wire of the same material. Modulus of elasticity of a cable depends upon the lay of the individual wires, the longer the lay the more nearly the modulus becomes equal to that of the solid material. Application of an initial stress should take place only during erection as winding on a reel after application decreases the effect originally obtained. Ha (14a)

A Metal Tender for "Britannia." *Motor Boat,* Vol. 59, July 6, 1933, pages 17-18. A launch built recently for the British Royal Yacht "Britannia" was constructed of M.G. 7 metal and with its 10-20 h.p. engine weighed only 9 cwt. This metal was in the form of angles and plates for the hull structure, and was used as castings for such parts as deck fittings, the propeller, the rudder, and the stern tube. JWD (14a)

Aluminum as Construction Material in Electrical Engineering (Aluminium als Baustoff in der Elektrotechnik) H. Schmitt. *Elektrizitätswirtschaft,* Vol. 32, Mar. 31, 1933, pages 124-125; *Polytechnisch Weekblad,* Vol. 27, Aug. 24, 1933, page 542. Due to improved refining processes, the conductivity of Al has been improved materially. Al for transmission purposes has a resistance of

$$0.02797 = \frac{1}{35.73}\ \Omega \text{ (1 m. length, 1 mm.}^2\text{ cross section and 20° C.) and}$$

$$0.02857 = \frac{1}{35}\ \Omega \text{ in the hard drawn state raising the T.S. to 16-17 kg./mm.}^2.$$

Hard drawn Al wires can be made for overhead transmission lines which have 61% of the conductivity, 1.64 times the cross sectional area, 1.28 times the diameter, and 0.5 times the weight of a corresponding Cu conductor. The balance of the paper stresses the importance of the oxidation processes used in coating Al. (Eloxal). A 110 volt Al coil with heat-proof oxide insulation compares as follows with a Cu coil provided with a double cotton covering:

	Cu	Al
Ampere turns	16,560	15,364
resistance (cold) Ω	24.5	24
current intensity amps.	4.5	4.6
current density amps./mm.^{2}	3	1.8
weight in kg.	31	13.5

Further utilization of oxidized Al incorporated in motors with short-circuited rotor for rolling mills and in electrolytic condensers is considered. WH (14a)

Aluminium as Structural Material (Aluminium als Konstruktionsmaterial) W. Zarges. *Werft, Reederei & Hafen,* Vol. 14, Sept. 15, 1933, pages 248-254. Considers Al and its alloys as sand cast, chill cast and worked material for structural engineering work with the viewpoint of a metallurgist and designer. Paper contains 2 large tables which accumulate hundreds of data on (a) 16 standard German Al wrought alloys in various heat-treated states and (b) on 21 commercial Al cast (sand and chill) alloys. Physical properties given are: tensile strength, yield point, elongation, Brinell hardness and shrinkage for (b), besides prices in Marks/kg., manufacturer and utilization, but no analyses. Average strength of 38-40 kg./mm.^{2} (at 15-25% elongation) can be attained without difficulty. By special alloying and mechanical treatment the strength can be raised to 60 kg./mm.^{2}. The foundry properties of Silumin are excellent, thus permitting wall sizes of 3-4 mm. Mg bearing Al alloys (KS Seewasser and Hydronalium) offer some difficulties. Silumin is also a material most indifferent towards shrinkage stresses. A 3 times greater deformation work is required for Al alloys in comparison with brass. The modulus of elasticity is 1/3 of steel, which is a valuable asset under dynamic stress but the buckling load is reduced to 1/3 of steel. Welding should be applied only to non-aging Al alloys. The essential differences between Al and steel rivets are discussed. 2 tables are given for (a) calculating the proper sizes of rivets with half round heads and countersunk rivets and (b) on admissible shearing stresses (90-95% accuracy) for 15 leading German Al-alloy rivets submitted to static, dynamic and vibration stresses. WHp (14a)

Sparking Plug Manufacture. *Automobile Engineer,* Vol. 23, Mar. 1933, page 88. Pt-Ir alloy was used for tips on early spark plugs. Substitutes now used are largely Ni alloys. Latest practice is to plate wires with a suitable deposit of the rarer metals. This process requires a bath, bracket for holding wires, and an accurately controlled micrometer arrangement for raising and lowering the wires. Electrolytes are largely composed of nitrates. RHP (14a)

Light Metals in the New German Patent Register (Leichtmetalle im neuen Reichspatentregister) *Aluminium,* Vol. 15, June 30, 1933, pages 3-5. The new subdivision in the classification of the German Patent Office is discussed with particular reference to light metals and alloys; the new arrangement facilitates reviewing the existing new processes and compositions patented and finding new ones. Ha (14a)

Aluminum in Transmission Lines (Aluminium im Fernleitungsbau) *Aluminium,* Vol. 15, Nov. 15, 1933, pages 4-5. Statistical data on lengths of high-tension lines over 85,000 volts in European countries and U. S. A. are reproduced. Ha (14a)

Aluminum in the Dairy Industry (Aluminium in der Milchwirtschaft) *Aluminium,* Vol. 15, May 31, 1933, page 6. Advantages of Al containers for transport and from the hygienic point of view, in the use of caps for bottles, etc., are pointed out. Ha (14a)

Recent Applications of Aluminum in the Electrical Industry (Neuere Anwendungsgebiete des Aluminiums in der Elektrotechnik) *Aluminium,* Vol. 15, May 15, 1933, pages 1-3; May 31, 1933, pages 1-4. Favorable experiences over 12 years have led to adoption of Al windings in transformers, large generators and short-circuit motors; saving weight in smaller motors up to 25%. The protection of Al wire by oxide films (eloxal process, etc.) is explained and examples for the steadily expanding fields in transmission lines cited. Ha (14a)

Advantages of Light Metals in Shipbuilding (Vorzüge der Leichtmetalle im Schiffbau) *Aluminium,* Vol. 15, Jan. 31, 1933, pages 1-3. Reduction of dead weight, increase of equipment for a given buoyancy, greater elasticity, the better distribution and reduction of stresses, etc. are discussed. Wooden parts and furniture can be replaced advantageously by light metal. Ha (14a)

Duralumin in Transportation Industry (Ueber Duralumin im Verkehrswesen) *Aluminium,* Vol. 15, Feb. 15, 1933, pages 1-4. The present applications in the manufacture of automobiles, aircraft and airships as well as in machine parts are reviewed and several examples calculated to show the possible savings in weight and money for the same conditions of performance. Ha (14a)

An Apartment House of Copper (Un Immeuble de Cuivre) *Cuivre et Laiton,* Vol. 6, Sept. 15, 1933, pages 424-425. A 7-story apartment house in Copenhagen is entirely covered with Cu on the outside walls and Cu alloys are used for ornamental purposes in many places. 110 tons of Cu were used for walls and roof. Some details are described and illustrated. Ha (14a)

Lead Alloys in Buildings. *Chemical Engineering & Mining Review,* Vol. 26, Oct. 5, 1933, page 45. For use in the construction of piping, roof sheets, and flashing two ternary Pb alloys have been studied. No. 1 contains 99.25% Pb, 0.25% Cd and .50% Sb, and No. 2 contains 98.25% Pb, 0.25% Cd and 1.50% Sn. Both alloys possess greater mechanical strength and resistance to fatigue than Pb yet retain the fine working properties. For piping the ternary alloys provide pipes of 30% less weight, for sheathing these alloys have 60% greater strength and 4 times the resistance to vibration of Pb of equal thickness. The Pb-Cd-Sn alloy is recommended for roofing sheets. WHB (14a)

A New Field for Application of Aluminum (Ein neues Anwendungsgebiet für Aluminium) H. Schuhmacher. *Aluminium,* Vol. 15, Oct. 31, 1933, pages 6-7. Guide rolls for threads in textile machinery are made of Al or light metal and Cr plated. This combines lightness (low inertia) with the required hardness of surface so that the thread will not cut into it. Ha (14a)

Metals for Reflectors. R. C. Roetger. *Product Engineering,* Vol. 4, Apr. 1933, page 137. Reflectors for arc lamps, telescopes, therapeutic lamps, etc., must not tarnish and must stand high temperatures, about 300° C. Silvered glass is physically not strong enough to stand abuse. Lately Cr, Al, Ni, alloys of Al-Cr-Ni, and several alloyed steels have been used more or less successfully. Curves are given showing their reflectivity in the range of ultra-violet and visible wave lengths (2000 to 6000 A.U.) Ha (14a)

Aluminum Enters Bridge Construction. Charles M. Reppert. *Engineering News-Record,* Vol. 111, Nov. 23, 1933, pages 611-615. High-strength Al alloy replaced old steel and timber floor of Smithfield Street bridge in Pittsburgh. Design was based on properties of 17 ST but floor members were made of alloy 27 ST which has superior physical properties and is more corrosion resistant. Alloys 4 SH and 53 ST were also used on the hand rail construction. CBJ (14a)

Tantalum as High-Grade Material for Manufacture of Artificial Silk Spinning Nozzles (Tantal als hochwertiger Werkstoff zur Herstellung von Kunstseide-Spinndüsen) F. Seehof. *Die Metallbörse,* Vol. 23, July 22, 1933, pages 926-927. The peculiar requisitions to be met with by spinning nozzles in regard to corrosion stability, hardness and resistance to wear are stressed. Glass, porcelain, Ni, Ag, and Mo failed in service. AuPt nozzles showed some deficiencies in physical properties, while the cheaper Au-Pd dies were successful. Recently Ta has been employed with notable success. The hardness and strength (90 $kg./mm.^2$) increases with rising oxygen contents. Difficulties due to the high m.p. of 2850° C. are overcome by the vacuum arc. Cleaning of the spinning nozzles can be carried out in HNO_3 owing to the great chemical stability of the metal. EF (14a)

Work of Data Committee on Aluminum Conductors (Arbeiten der Fachausschüsse: Ausschuss für Aluminiumleitungen) H. Schmitt. *Zeitschrift für Metallkunde,* Vol. 25, July 1933, pages 170-172. A report on the behavior of Al conductors installed on the island Sylt over a period of 5 years. The conditions of construction and of exposure are described. These conductors consisted of Cu; Aldrey; Al, 99.6; Al, 99.2, annealed at 350°; Al, 99.2, annealed at 500°, "test alloy No. II." Photographs show the progressive change in surface appearance of the cables, and graphs show the change in breaking load, corrected breaking load, and electrical resistance over the 5-year period. The Al conductors showed good behavior in comparison with Cu. RFM (14a)

Aluminum Cast Alloys (Aluminium-Gusslegierungen) R. Irmann. *Aluminium,* Vol. 15, Nov. 15, 1933, pages 2-4. Cast Al alloys are now especially used in replacing cast iron and bronze where light weight is of importance; Al with Cu, Cu-Zn, and Si being mostly used. Machining of the casting can often be omitted if the mold was sufficiently exact and gives a neat casting; die-castings can be made so exact to dimension that subsequent machining is not required. Modern heat-treated Al alloys possess such good mechanical properties that 60-80% of the section of the piece in cast iron is sufficient for the same strength. High tensile strength and resistance against corrosion combined with low weight find for these alloys wide use in many fields of industry; several are enumerated with the particular property important in that respective case. Ha (14a)

Squirrel Cage Motors Made of Cast Aluminum (Les moteurs asynchrones à cage d'écureuil en aluminium coulé) N. Hubert. *Revue de l'aluminium et de ses applications,* Vol. 10, July-Aug. 1933, pages 2178-2180. A short description of squirrel cage motors made of aluminum cast under pressure. AH (14a)

Wire for Resistance Furnaces. A. G. Arend. *Electrical Review,* Vol. 113, Aug. 25, 1933, page 248. Outline of manufacture of Ni-Cr alloys. MS (14a)

Die Casting (Über Spritzguss) Hermann Christen. *Schweizerische Bauzeitung,* Vol. 102, Oct. 14, 1933, pages 195-198. The various casting methods are first considered, the advantages of die casting are then discussed. Principal advantages are: clean and smooth surface, sharp contours, thinner wall thicknesses can be attained than by other casting methods, high accuracy of dimensions saves subsequent working, other metals and materials can be inserted by die casting. In die casting Al, for instance, difficulties in soldering Al, can be eliminated. Die cast metals show better structure than sand and mold cast metals. Field of application is outlined, as for automobile parts, parts of electrical machinery and instruments, parts of radio and telephone apparatus, etc. GN (14a)

The New Suburban Two Floor High Railway Carriages of the State Railway, France (Les nouvelles voitures de Banlieue dites à étages du réseau de l'Etat) M. Lion. *Revue de l'aluminium et de ses applications,* Vol. 10, July-Aug. 1933, pages 2165-2170. A decrease in weight of 10% was brought about by replacing steel and brass parts by aluminum and some of its alloys. AH (14a)

Light Alloys for Transportation Equipment (Les alliages légers dans le matériel de transport) A. Dumas. *Revue de l'Aluminium et de ses alliages,* Vol. 10, May-June 1933, pages 2090-2098. A description of various railroad cars built of light alloys. AH (14a)

The Development of Light-Weight, High-Speed Passenger Trains. E. E. Adams. *Mechanical Engineering,* Vol. 55, Dec. 1933, pages 735-740; also paper presented at annual meeting of A. S. M. E., New York, Dec. 4-9, 1933. This is an "official" technical description by the vice-president of Pullman, Inc., of the train soon to be operated on special runs between larger cities on Union Pacific system, with purpose of demonstrating its practicability for regular main-line through-passenger-train service, including transcontinental. Design based largely on automotive and aircraft developments. After study of all available materials, it was decided to use Al alloys for entire car structure, except for bolsters, articulation castings, and truck frames, which parts are made of a special alloy cast steel having high tensile strength, high yield point, and great ductility. Result is estimated weight of 160,000 lbs. for the 3-car train. MFB (14a)

The Present Status of the Cast Gold Inlay. R. K. Brown. *Journal American Dental Association,* Vol. 20, Oct. 1933, pages 1841-1850. The direct and indirect technics of preparing the wax pattern are compared, with the conclusion that the direct method of preparing the wax pattern in the cavity gives the more accurate reproduction when the cavity is accessible, but the indirect method has many advantages and conveniences for the dentist and patient. Different types of cavity preparations are discussed. The remainder of the paper deals with expansion and contraction of the materials used in the various steps in producing the cast inlay and gives details for minimizing and compensating these dimensional changes. OEH (14a)

Light Alloy Pistons. J. S. Irving. *Automobile Engineer,* Vol. 23, Jan. 1933, pages 19-22; Feb. 1933, pages 57-60. Attempts to summarize progress to date, tabulate the requirements for a modern piston, and to indicate line of future development. Al alloy pistons were used experimentally before the World War. Best results were obtained with an Al-Cu 11-13 alloy. This alloy is still used as a standard with which other alloys are compared. Chief defects are high coefficient of expansion, and poor physical properties at high temperatures. To counteract the high expansion the skirts of the piston are now supported on Invar steel strips. Piston requirements are: 1. low weight, 2. high thermal conductivity, 3. strength at high temperatures, 4. low coefficient of expansion, 5. resistance to wear, 6. stability of structure. Formulas and calculations are given showing inertia losses in proportion to weigh. A graph indicates piston temperatures of cast iron, and Al-Cu pistons in a water-cooled motor running under full load, water temperature 85° C., and oil temperature 75° C. Figures indicate relative strength of forgings and castings. Forgings are superior, showing practically no change in physical properties of the Al-Cu alloys up to 200° C.; between 200°-380° C. there is a sharp drop after which there is a recovery up to 450° C. Normal engine temperature is about 200° C. with a maximum of 300° C. Friction test results are shown for die cast alloy pistons and forged alloy pistons. Resistance to wear is dependent upon composition, density of structure and friction. Table shows relative wear of cast iron, and various Al alloys. RHPp (14a)

Alfol in Shipbuilding (Alfol im Schiffbau) H. Niemann. *Werft, Reederei und Hafen,* Vol. 14, Sept. 15, 1933, pages 260-263. "Alfol" is not an insulation material but an insulation method. Metal foils are placed perpendicular to the direction of the heat current as to produce air walls of the greatest insulation power. The underlying physical principles are exhaustively treated. Plain sheets of 0.015 mm. and crumpled foils of 0.007 mm. thickness are employed. The former method is only suited for straight walls, the latter for any shape. Alfol insulation is not hygroscopic in contrast to most organic materials (cork) which are liable to rot. The corrosion danger with Al insulation material is banned by using pure Al, by certain structural tricks, or by protective oxide or lacquer layers. The insulation power of cork drops 80% due to 6% by volume of moisture, while the heat transmission cannot increase more than 10% for Alfol. The fire-proofness of Alfol is based on its non-combustibility. Above the melting point of Al (650° C.), Al oxide is formed which represents one of the most refractory materials. The sound insulation properties of sheet iron, tuff-stone, wood, cork, Alfol + asbestos, Alfol + Al wool is shown in a diagram, wherein wall weight in $kg./m.^3$ is plotted against insulation ability in phon. Conspicious advantages on the side of Alfol cannot be claimed so far. WHp (14a)

Light Metal Construction in Shipbuilding (Leichtmetall-Konstruktion im Schiffbau) Fr. Gentzcke. *Werft, Reederei und Hafen,* Vol. 14, Sept. 15, 1933, pages 256-260. Treats the subject under the following main viewpoints: (1) advantages of savings of weight, (2) various types and extent of weight reductions, (3) increase of safety and comfort of traveling, (4) present day possibilities as limited by light metal design and manufacture. Replacing steel by light metals in ship-building involves gain in buoyancy, smaller ship dimensions and propulsion engines. Uses mentioned: accommodations in staterooms, kitchens, etc., lead wires, pipe lines, doors, windows, furniture, bridge, funnels, ventilators, masts and other parts of the upper-structure. The weight reduction is based on (1) the lower ratio of specific weight: maximum load (steel = 0.52, light metal alloy Bondur = 0.23, wood = 0.65) (2) on the 3 times higher modulus of elasticity of steel which can be replaced by light metals weighing 1/4-1/5 of the steel member. The utilization of forged and cast light metals in engine construction is dealt with. Further assets considered are non-inflammability, heat and sound insulation ability, suitability for rigid joints, adaptability in regard to aesthetic effects. The Al "Sperrplatte" is introduced consisting of 2 thin sheets spaced 5-15 mm. apart and filled in with compressed Al woven wool. Fe threads burn, but not Al ones. Al panels do not rust and can be easily provided with all kinds of patterns. The technological difficulties formerly met with on rolled, pressed and cast Al alloys are largely overcome. There are some difficulties with Hydronalium and KS Seewasser. The chemical resistance against seawater has been materially raised by special alloying. A table gives the best suited Al alloys, their tensile strength and utilization in ship-building. Commercial profiles are listed. Some representative applications are shown in 11 illustrations. WHp (14a)

Tanks of light alloys for compressed gases (Bombole in lega leggera per gas compressi) E. Franchi. *Alluminio,* Vol. 2, May-June 1933, pages 127-138. The manufacture of tanks of avional, anticorodal, and lautal whose compositions are shown below, is described:

	Cu	Si	Mn	Mg	Fe	Al
Avional	4%	0.6%	0.6%	0.6%	0.35%	balance
Anticorodal	–%	1.0%	0.6%	0.6%	0.35%	balance
Lautal	4%	2.0%	–	–	0.35%	balance

The mechanical and structural characteristics are given. The deformation at increasing pressures up to 225 atms. was measured, by placing the bombs within a larger tank which is sealed, the deformation being measured by the amount of water displaced, which is measured by a tube attached like a pressure gauge. Some bombs were tested up to the point of rupture, 2 avional bombs burst at 570 and 600 atms., while the lautal bomb failed at 700 atms. AWCp (14a)

Large Statues of Hammered Copper (La Statuaire de grands Dimensions en Cuivre martelé) G. DuBois. *Cuivre et Laiton,* Vol. 6, Apr. 30, 1933, pages 187-194. General description of processes and examples of remarkable statuary and ornamental work in Cu. Ha (14a)

Application of Copper in the Modern Brewery (Das Kupfer im neuzeitlichen Brauereibetrieb) Josef Mederer. *Apparatebau,* Vol. 45, Oct. 27, 1933, pages 121-128. After discussing the physical and chemical properties of Cu playing a role in brewery equipment the manifold possibilities of application of Cu in this industry are outlined with special reference to the constructions of brewery equipment. GN (14a)

Zeppelin's New Airliner. Wolfgang Lambrecht. *Aviation,* Vol. 32, Nov. 1933, pages 344-346. Tests are scheduled for the fall of 1934 on a new craft, the LZ-129, which has 4 times the passenger capacity of the Graf Zeppelin. The frame is made of duralumin. The covering will be doped with aluminum powder to minimize the effect of heat rays. DTR (14a)

Light Alloys for Aeronautical Purposes with Special Reference to Magnesium. Leslie Aitchison. *Metallurgia,* Vol. 9, Dec. 1933, pages 49-52. Review of lecture before Royal Aeronautical Society on Dec. 14, 1933. JLG (14a)

Aluminum and Its Alloys in Ship and Airplane Building (Aluminium and seine Legierungen in Schifffahrt und Luftfahrt) E. Foerster. *Technische Blätter der deutschen Bergwerkszeitung,* Vol. 23, Oct. 8, 1933, pages 564-565. Discusses use of Al alloys in ship, airship and airplane construction with particular reference to economic advantages. GN (14a)

Bells and Carillons (Cloches, Clochettes et Carillons) V. Cheilly. *Cuivre et Laiton,* Vol. 6, May 30, 1933, pages 243-245. Manufacture of bells, gongs, carillons, etc., is described briefly. The tonal qualities can be obtained only with pure Cu-Sn alloys with about 22-25% Sn; the latter percentage prevails in the excellent gongs, tom-toms, cymbals of oriental makers. Ha (14a)

Platinum and the Jewelry Trade (Platin und die Schmuckwarenindustrie) W. Geibel. *Deutsche Goldschmiedezeitung,* Vol. 36, Oct. 21, 1933, pages 467-468. Discusses use of Pt and Pt alloys in jewelry trade. GN (14a)

Equipment for Gardening (L'outillage de l'horticulture) J. Bally. *Revue de l'Aluminium et de ses applications,* Vol. 10, July-Aug. 1933, pages 2181-2188. A fully illustrated description of the use of Al and its alloys for the mentioned purpose. AH (14a)

APPLICATIONS OF METALS & ALLOYS (14)

Ferrous (14b)

M. GENSAMER, SECTION EDITOR

The All-Welded Ship? E. F. Spanner. *Welder,* Vol. 5, Sept. 1933, pages 23-29. The conditions, methods and design features which would have to be developed to make an all welded ship a reality, are discussed. Although at present not yet existing the ideal will, in the writer's opinion, be realized some day. Ha (14b)

Welded Tubing for Automobile Use. W. E. Stine. *American Machinist,* Vol. 77, Mar. 1, 1933, pages 137. Tapering tubes are preferably made by welding instead of swaging straight seamless tubes. A few examples of how it is done in some automobile factories are briefly described. Ha (14b)

The Case for Steel Weldings versus Castings. C. H. Stevens. *Welder,* Vol. 5, Sept. 1933, pages 29-34. Advantages of building-up parts by welding instead of casting are discussed and it is shown by a comparison that design, procuring of materials needed and the product required can be obtained in shorter time. The method of using steel welding instead of casting is illustrated in a Diesel engine, columns of a submarine engine and a large marine engine. Ha (14b)

A Contractor's View of Welded Piping. H. Wetzel. *Electric Welding,* Vol. 3, Nov. 1933, pages 20-22. Welded pipe lines have proved fully satisfactory under every condition of stress, but if used all other types of joint, screws, flanges, etc., should be eliminated and no harder tests prescribed than those actually required to give sufficient safety to meet operating conditions. Which of the 3 processes, namely oxy-acetylene, metallic electric arc and flash-type butt-welding, should be employed must be decided by size and quantity of welds, amount of cutting and trimming compared with welding, availability of electric current and skill of welders. The points are discussed at some length. Ha (14b)

Stainless Steel in Aircraft Construction. E. J. W. Ragsdale. *Transactions American Society of Mechanical Engineers,* Vol. 5, *Aeronautical Engineering Section,* Apr.-June 1933, pages 89-95. The use of stainless steel, especially of the 18-8 alloy is discussed; by recognizing properly the possibilities, correct design and cost, it can be used to a great extent, as has been shown in England. A trend toward it here in the U.S.A. has been noted. Some technical points of treatment and working methods are described. Ha (14b)

Manufacture of Those Parts of Large Machine Tools having Bearing Surfaces (La Fabrication des Pièces à Parties frottantes des grosses Machine-Outils) Prévost. *Bulletin de l'Association Technique de Fonderie,* Vol. 7, Dec. 1933, pages 485-488; *Usine,* Vol. 42, Dec. 21, 1933, page 31. Principles are developed for design and proper casting of parts of large lathes, planers, turntables, etc., and the points important in molding and casting with regard to expansion and deformation under stress discussed. WHS+Ha (14b)

New Freight Locomotives for Russia (Nouvelles Locomotives à vapeur à Marchandises pour l'U.S.S.R.) *La Téchnique Moderne,* Vol. 25, July 1, 1933, pages 456-458. Description of locomotives of the 151 type constructed by Baldwin Locomotive Co. of the 241 + 142 Garratt type manufactured by "Beyer" in England and of the 172 type. Fire-box of the latter is mentioned as being made of welded steel plates. Numerical data concerning the 3 types of locomotives are given in tables. FR (14b)

Large Uses of Steel in Small Ways. No. 234-253. *Steel,* Vol. 92, Jan 9, 1933, page 25; Jan. 23, 1933, page 24; Feb. 6, 1933, page 34; Feb. 20, 1933, page 26; Mar. 6, 1933, page 28; Mar. 20, 1933, page 32; Apr. 3, 1933, page 26; Apr. 24, 1933, page 37; May 15, 1933, page 32; May 29, 1933, page 32; June 19, 1933, page 30; Vol. 93, July 17, 1933, page 34; Aug. 7, 1933, page 38; Aug. 28, 1933, page 41; Sept. 11, 1933, page 37; Oct. 2, 1933, page 40; Oct. 16, 1933, page 40; Nov. 6, 1933, page 45; Nov. 27, 1933, page 30; Dec. 18, 1933, page 35. Deals with the use of steel in, and the manufacture of bottled beverage coolers; industrial trailers; railroad spikes; dictating machines; picture puzzles; clothes dryers; pin games; engravers' steel; ship anchors; baby carriages; cigarette machines; machines for sanding, waxing, polishing, and scrubbing floors; wire-rope highway guards; sliding fire-escapes; tackle-blocks; automobile trunks; sign stands; gas home heaters; linemen's climbers; and ice-tongs. MS (14b)

Electrically Welded Steel Grates for Automobile Highways (Elektrisch geschweisste Stahlrostdecke für Autostrassen) *Elektrizitätswirtschaft,* Vol. 32, Sept. 15, 1933, page 410. A vast utilization of steel for this nation-wide enterprise in Germany is indicated. The grate consists of zig-zag bent flat iron rods of 22 x 7 mm. laid across the street and attached by electric welding at a distance of 3-6 mm. to 50 x 5 mm. steel bars running in the direction of the highway. The space between the bars is filled in with bitumen. Price = 8 — 9 R.M./m.^{2} road surface. The stability, easy laying out of the road, and prevention of skidding of vehicles are emphasized. EF (14b)

Pure Iron. Use of 100 Per Cent Pure Iron in the Electrical Industry. *Electrician,* Vol. 111, Dec. 8, 1933, page 714. Discussion of the use of 99.9^{+}% Fe for use in wireless valves. CBJ (14b)

A Steel that Minimizes Warping and Distribution. *Edgar Allen News,* Vol. 12, Oct. 1933, pages 321-324. An oil-hardened steel, type K-9, for dies, taps, punches, etc., and its properties and treatment are described. Ha (14b)

Inland Steel Co. Builds Aerial Tram. *Iron Age,* Vol. 131, Mar. 16, 1933, pages 430-431. Describes a new semi-automatic tramway installed at Wheelwright, Ky., coal mine of Inland Steel Co. VSP (14b)

1850-Foot Sky Ride at World's Fair Embodies Spectacular Design. *Steel,* Vol. 92, Jan. 23, 1933, pages 17-18. Towers, 628 ft. high and 1850 ft. apart, support track cable system at an elevation of about 234 ft. Project requires about 2000 tons of structural steel and 1000 tons of cable. Embodies welded and riveted construction. Specially designed welding-machines were required. MS (14b)

Experiments with Chromium Steel for Dental Use. *Steel,* Vol. 92, Mar. 27, 1933, page 27. Note on a demonstration of Cr steel as a substitute for Au dentures at the annual clinic of the Toronto Academy of Dentistry, Toronto, Ont. The steel is much less costly, has all the attributes of Au, and is stronger. Outstanding difficulty lies in its being harder to handle than Au. At present the work on a Cr steel denture brings its cost up to that of Au. MS (14b)

Improvements in Iron and Steel Meet the Designer's Needs. *Machinery,* New York, Vol. 39, Jan. 1933, pages 331-334. Summary of recent developments in iron and steel metallurgy. Includes stainless steel with free machining qualities, 18-8 stainless steel, mild steel sheet with veneer of stainless steel, new 2-ply stainless steel, nitrided steel, "Elinvar," improved C-steel castings, high strength alloy steel castings, heat resisting cast iron used for Al melting pots, new method of producing gray iron castings in permanent molds, centrifugal method of casting for pipe production, and new developments in malleable iron castings. RHP (14b)

Manganese Steel for Dredge Parts. *Oxy-Acetylene Tips,* Vol. 12, Sept. 1933, page 203. Mn steels containing from 12-14% Mn are used in practically all parts of dredges on account of their great resistance to impact and abrasion and extreme toughness. Ha (14b)

Food and Stainless Steels. *Oxy-Acetylene Tips,* Vol. 12, Nov. 1933, pages 257-258. Stainless straight Cr steels (12-18%) or austenitic 18-8 steels have given good results in the food industries. Examples of bakery equipment, kitchen utensils and installations, etc., are shown. Ha (14b)

Alloy Steels in Mining Machinery. *Engineering,* Vol. 155, June 23, 1933, page 622. Short note outlining various alloy steels suitable for machinery parts subjected to severe wear, shock and corrosion. LFM (14b)

Modern Steels and Their Uses. A. C. Rowe. *English Mechanics,* Vol. 14, July 21, 1933, pages 261-262. The significance of the induction furnace for producing high grade steels is emphasized. Superior dies for lining brick and tile press boxes resulted in treble life of the lining apart from securing better bricks. Special alloy steels for spades, shovels and similar implements last from 3-5 times as long as the ordinary tool (0.4 C, 0.6 Mn, 1.25 Ni, 0.8 Cr). W and Cr bearing steels for files, pins for sand mixing machines, Ni-Mo containing saw steels with high elastic limits, Mn steels for crushing, grinding and excavating machinery, two-ply stainless and stainless steels with higher S or a low Se content are reviewed. WH (14b)

Modern High-Grade Structural Steels (Moderne Hoogwaardige Constructiestalen) P. Schoenmaker. *De Ingenieur,* Vol. 48, Aug. 4, 1933, pages W.141-W.144. The development of structural steels is briefly discussed and compositions and properties of American and German high-grade steels for structural purposes described. Ha (14b)

Notes on the Material for Railway Axles (Consideraciones sobre el material de los ejes para ferrocarriles) Ramon Simon. *Revista de Ingenieria Industrial,* Vol. 4, Aug. 1933, pages 261-262. The author stresses the need for use of steels with high C and Mn content to obviate axle failures. Railroad axles are subject to vibration which causes cracks to form in axles that are apparently sound. The dimensions of axles used in the United States and Spain are given with the bases for their design, and an equation for calculating the forces acting upon them. RRS (14b)

Does the German Coal Mining Industry Need New Steel Stemples? (Braucht der deutsche Steinkohlenbergbau für den Abbau mit Teilversatz neue Stahlstempel?) R. Würker. *Technische Blätter der deutschen Bergwerkszeitung,* Vol. 23, Sept. 29, 1933, pages 528-529. Describes various types of rigid steel stemples which are better than corresponding English constructions. GN (14b)

Selection and Heat Treatment of Steel for Caterpillar Tractors. G. C. Riegel. *Iron Age,* Vol. 131, Mar. 23, 1933, pages 468-469, adv. sec. pages 12, 16. See "Material Selection in Caterpillar Plants," *Metals & Alloys,* Vol. 4, Nov. 1933, page MA 353. VSP (14b)

Modern Engineering Constructions with Steel Piling (Moderne Ingenieursbouwwerken met stalen damwand) L. E. Todsen. *De Ingenieur,* Vol. 48, May 19, 1933, pages B99-B100. The various profiles of steel piling and their applications are generally described and advantages over wood piling discussed. Ha (14b)

New Needs and New Methods (Moyens et Besoins Nouveaux; Methodes Nouvelles) *L'Usine,* Vol. 42, Jan. 13, 1933, pages 25-27. Examples of forged and welded frames, stands, housings, etc., of large presses are described and illustrated. Ha (14b)

Special Steels (Aciers Spéciaux) *L'Usine,* Vol. 42, Apr. 21, 1933, page 23. Special steels and metals made by Schneider in their French works are briefly described; among others are "Virgo," a non-oxidizing steel under the action of salts and at elevated temperatures; "Alferium," a light metal of 2.85 density, 38 kg./mm.^{2} tensile strength, 22 kg./mm.^{2} elastic limit, and 16% elongation; casting and forging bronzes in ingots of 40-200 kg. with 2% or 10% Al. The various fields of employment are enumerated. Ha (14b)

New Tankcars for Railroads (Neue Behälterwagen für Eisenbahnen) *Technische Blätter der deutschen Bergwerkszeitung,* Vol. 54, Sept. 24, 1933, page 512. Description of new types of steel built tank cars for the transportation of powdered products, such as concrete. GN (14b)

The New Three Cylinder, Single Expansion Locomotive Type "Mountain" 241.101 of the State Railways. (France) (La nouvelle locomotive "Mountain" 241.101 des chemins de fer de l'Etat, à trois cylindres à simple expansion) *Revue du Nickel,* Vol. 4, July 1933, page 83. A short description of the alloy steels used for some parts of this new locomotive. AH (14b)

Transmissions of Motion by Gears (Des Transmissions par Engrenages) R. Pouille. *Arts-et-Métiers,* Vol. 85, July 1933, pages 251-256. Wear, lubricating of gears as well as toothless gears are studied. Dealing with the matter of wear, the author gives particulars concerning metals to be used for speed reducer gears. Cast Fe, cast steel and forged steel of less than 70 kg./mm.^{2} strength are worn out too rapidly. Gears for such an application must be made from steel treated for a strength of 80-100 kg./mm.^{2} or in quenched steel but, in this case, teeth and bores must be ground after quenching. For wheels of great size, hubs are made of high strength cast Fe (semi-steel) upon which a treated steel hoop is placed, preferably at 200°-300° C., and set in position through studs. FR (14b)

"Lunz" Iron, a New Metal for Molds. *Glass,* Vol. 10, May 1933, pages 198. A new material for glass molds has been developed by E. Lunn & Co., Glasgow, (composition not given) which eliminates the troubles encountered in cast iron usually employed for molds in making glass ware. It is claimed the material will not grow, warp or distort in any way and will retain its original dimensions after years of operation. The castings of the material show practically no grain and take a very high polish. Ha (14b)

New Type of Reinforcement for Concrete Constructions (Eine neuartige Bewehrung für Beton- und Eisenbetonbauten) A. Kleinlogel. *Schriften der Hessischen Hochschulen,* 1933, No. 2, pages 1-12. Paper before Werkstofftechnisches Kolloquium der Staatlichen Materialprüfungsanstalt an der Technischen Hochschule Darmstadt, June 24, 1933. Paper deals at length with a new method of increasing the resistance of concrete against crack formation. This is attained by a new type of wire gauze, the Benzinger gauze. The Benzinger gauze is made by interweaving steel rods in common fence wire or similar gauze. A special machine, the Benzinger arming machine, has been developed for this purpose. Results of practical tests with new gauze are given, extensive field of application is outlined. GN (14b)

Cast Iron Pipe Used in Large Sewer Construction. H. H. Hendon. *Water Works & Sewerage,* Vol. 81, Jan. 1934, pages 23-24. Consideration of type of ground in which sewer pipes were to be laid, and of economy in investment led to selection of cast iron sewer pipes of 42.6 in. dia. Ha (14b)

Equipment and Methods Used in Molding Plastic Materials. C. W. Hinman. *Machinery,* N. Y., Vol. 39, Apr. 1933, pages 530-532. Low C steels may be used for these molds but the better grades are advised. Mold surface hardness is usually 53 to 55 Rockwell. Drawing temperature should be the working temperature of the mold, but at least 450° F. RHP (14b)

A Few Applications of Nickel Steels (Note sur quelques applications des aciers au nickel) J. Oudet. *Revue du Nickel,* Vol. 4, July 1933, pages 84-86. A description of attempts to displace plain carbon steels by nickel alloy steels or cast irons in some parts of locomotive. For parts whose dimensions cannot be readily changed, nickel alloy steels and cast irons successfully increase strength. AH (14b)

Structural Steel Mesh (Das Baustahlgewebe) J. Letschert. *Technische Blätter der deutschen Bergwerkszeitung,* Vol. 23, Aug. 20, 1933, page 454. Instead of strengthening concrete constructions by single steel rods a new method has recently been developed in which the longitudinal and transverse rods or wires are welded to a unit by spot welding machines. The advantages of this netlike reinforcement are considered. GN (14b)

The Shape of the Drill Bit. V. S. Fedorov. *Groznenskii Neftyanik,* Vol. 2, Nov.-Dec. 1932, pages 37-45. (In Russian). An investigation carried out with bits of various shapes used in drilling holes in various strata showed that the cutting angle and the angle of the cutting edge is of the greatest importance. The best cutting angle for soft minerals is 70°, for hard ones 90° and for clays intermingled with sand layers 80°. The angles of the cutting edges are calculated on the basis of the stresses encountered during the operation. Experience showed that these angles should be 20° for clay and 40° for hard minerals. AAB (14b)

Nickel in Automobile Construction (Le nickel dans la construction automobile) M. Godefroid. *Revue du Nickel,* Vol. 4, Oct. 1933, pages 125-136. A detailed and comprehensive description of the use of nickel as an alloying element for automobile construction giving compositions, heat treatments, and properties in four sections a) stainless and structural steels, b) cast irons, c) non-ferrous alloys, d) electrolytic coatings. AH (14b)

Nickel in Airplane Construction (Le nickel dans l'aviation) Pierre Blanchet. *Revue du Nickel,* Vol. 4, Oct. 1933, pages 103-118. Review of the uses of nickel and nickel alloys (ferrous and non-ferrous) in airplane construction, giving detailed compositions, heat treatments and properties. AH (14b)

Reinforced Concrete Versus Steel. The Case for Reinforced Concrete. N. B. Liversedge. *The Structural Engineer,* Vol. 11, Sept. 1933, pages 369-372. **The Case for Structural Steel.** A. J. Hodgkinson. pages 372-378. A debate on this subject was arranged by the Yorkshire Branch of the Institution of Structural Engineers. Liversedge claims that reinforced concrete is the better material for water towers and tanks, building and bridges except where freak spans and heights are required. He considers the field of framed buildings as the most controversial one. Reinforced concrete is almost unchallenged in the modern heavy duty road and concrete lining of pipes, culverts, etc. Easy cleaning, low maintenance costs, capability of beautiful and harmonious effects and possibilities of using local materials are claimed as valuable assets on the side of reinforced concrete employed for tanks, bunkers, hoppers, silos, bridges, framed buildings, etc. Hodgkinson calls attention to the important role which steel plays in reinforced concrete and critically discusses the usefulness of both construction materials from architectural, structural and economic viewpoints. WH (14b)

Nickel Steel in the Construction of Railroad Cars (Note sur l'utilisation de l'acier au nickel dans la construction des nouvelles voitures métalliques de banlieue du réseau de l'Etat) M. Lion. *Revue du Nickel,* Vol. 4. July 1933. pages 80-82. The use of nickel steel instead of plain carbon steel brought about a decrease in weight of about 30%. The composition and properties of the steel used which has excellent mechanical and welding properties is as follows: C$\leqq$ 0.2%, Si $\leqq$ 0.2%, Mo = 0.3%, Ni = 1.5%, Cr = 0.5%, elastic limit: 42 kg./mm.^{2}, tensile strength: 60 kg./mm.^{2}, elongation: 18%. A description of working and treatment is given in detail. AH (14b)

A Steel Rail Congress. Cecil J. Allen. *The Railway Engineer,* Aug. 1933, pages 252-254. A review of some of the subjects discussed at the International Rail Assembly at Zurich. Medium Mn steel is now firmly established on the mainland of Europe. The rail compositions favored by some countries

	C	Mn	Si	S	P	
Italy	.35-.50	.9-1.4	.05-.20	.06	.04	basic open hearth
Switzerland	.40-.48	.9-1.1	.35 max.	.05	.08	basic Bessemer
Spain	.50-.60	.8-1.2	.15-.25	.07	.07	acid Bessemer

With basic open hearth steel, the C content increases to 0.55-0.65%, but Mn is reduced to 0.70-0.95%. In Italy a steel containing up to 0.6% Cu is recommended to provide resistance to corrosion in tunnels. But more attention appeared to be devoted to heat treatment than to alloys for increasing wear resistance. Martensitic rails are produced in Germany and France (Brinell hardness = 475) and a sorbitic quality has been rolled for the Swiss Federal Railways (Brinell hardness = 330-390) and in Luxembourg. Attention is called to the electro-Mn-steel process of the Austrian Alpine Montagesellschaft raising the tensile strength of normal open-hearth steel from 46 tons/in.^{2} to 59 tons/in.^{2} (No non metallic inclusions and 1.80% Mn) and to the compound cast steel for rails with a flange of 0.2-0.3% C and 140-170 Brinell and a head of 0.7% C and 300-400 Brinell. The balance of the paper discusses the methods of testing rails, rolling mill practice and rail defects. WH (14b)

Design and Installation of Large Water Mains. C. J. Des Baillets. *Canadian Engineer,* Vol. 64, Mar. 28, 1933, pages 54-57. Paper before the Canadian Section of the American Water Works Association, Ottawa, Mar. 22. A brief for reinforced concrete-steel pipe. VVK (14b)

Chromium Nickel Steels and Airplane Construction (Les aciers au Nickel-chrome auto-trempants et la construction aéronautique) Louis Brequet. *Revue du Nickel,* Vol. 4, Oct. 1933, pages 118-124. Chromium nickel steels of the 18-8 type have an elastic limit 5½ times that of duralumin, cost 40% less and weight 1.79 times more. They are highly sensitive to heat treatments and have excellent mechanical, chemical, and forming properties. Therefore for certain parts of airplanes they are used instead of light alloys. Two important points need extensive development (a) the protection of light alloys against corrosion and the application of ultra-light alloys such as Mg and eventually Be, (b) the production of stainless steels having good welding properties. AH (14b)

Stainless-Clad Steel Adapted to Tonnage Production. S. L. Ingersoll. *Steel,* Vol. 92, Feb. 6, 1933, pages 28, 30. Material consists of a thin surface of stainless steel on a mild-steel backing. Sheets are rolled from a composite ingot. They may be deep drawn, stamped, formed, welded, and highly polished. Material may be fabricated with the same equipment used on corresponding gages of ordinary soft steel. It sells at 40-50% less than the cost of the solid alloy. It has numerous applications, limited to those in which a continuous surface is exposed to corrosion, heat or abrasion. MS (14b)

Beer—What Will It Mean for Steel? A. H. Allen. *Steel,* Vol. 92, Mar. 27, 1933, pages 11-12, 24-26. Discusses the possibilities of the brewing industry as a market for iron and steel manufacturers and fabricators. As greatest opportunities seem to lie in the field of stainless steel, reviews European developments in the adaptation of this steel to brewery equipment. MS (14b)

Castings Speed Transport Planes. R. E. Johnson. *Foundry,* Vol. 61, Aug. 1933, page 21. Castings are preferred over fabricated steel fittings because of lower cost and superior rigidity. Al alloys are used to eliminate corrosion and at the same time they can be cast into complicated designs. 183 castings are used in each of 60 planes. VSP (14b)

Rustless Steels Employed in Fan Construction. M. S. Kice, Jr. *Iron Age,* Vol. 131, Mar. 30, 1933, pages 506-507, adv. sec. pages 10, 12; Apr. 6, 1933, pages 542-543. Rustless steels, both high Cr and 18-8 types, used for fans operating above 750° C. in corrosive gases. Selection of steel is based on its resistance to corrosion, ease of fabrication, creep and price. Cr steel serves well below 950° F., but for 1000° to 1200° F., 18-8 should be used. VSP (14b)

Using Tubes as Structural Members. A. F. Burstall. *Welding Engineer,* Vol. 18, Jan. 1933, pages 21-23; Feb. 1933, pages 21-25; Mar. 1933, pages 18-21. The many possibilities of using tubes as struts, ties, etc., and the method of welding them are illustrated. Means of corrosion-prevention are discussed. Cost analyses are made. Ha (14b)

Possibilities of Corrosion Resisting Metals. L. S. Hamaker. *Sheet Metal Worker,* Vol. 24, June 1933, pages 185-186, 190. Points out the possibilities and advantages of the use of stainless steel in the small hardware trade, for business signs, etc. Ha (14b)

Hardened Ways for Machine Tools. Charles Golosman. *Machinery,* N. Y., Vol. 39, Aug. 1933, page 760. Brief discussion of the use of hardened and ground steel linings or plates for the ways of machine tools. These effectively prevent wear. RHP (14b)

Nickel Cast Irons for Automobiles and Internal Combustion Engines (Les fontes au nickel dans l'automobile et les moteurs à combustion interne) M. Ballay & R. Chavy. *Revue du Nickel,* Vol. 4, Oct. 1933, pages 145-159. A review of the effect of nickel on cast irons and the application of nickel cast irons in internal combustion engines. Detailed compositions, heat treatments and properties are given. 10 references. AH (14b)

What Metals to Use in Anthracite-Breaker Chutes. Walter L. Keene & David F. McFarland. *Coal Age,* Vol. 38, Oct. 1933, pages 335-336, 341. Relative wear and cost of a series of alloys were compared with that of materials now in use. A combined corrosion and abrasion test was devised using mine water as the corrosion medium and egg and pea sizes of anthracite coal to furnish the abrasion. The test was run for three weeks. Cr and Cr-Ni alloys of Fe withstand the combined action of mine water and sliding coal abrasion much better than does plain C steel. A special 20% Cr 1% Cu alloy is superior to the ordinary Cr alloy. Two 18-8 steels and a high Cr (27%) are next; followed by a 12-14% Cr, 0.12% C steel; a 16-18% Cr, 0.10% C; and a 12-14% Cr, 0.30% C steel. Phosphor bronze is more resistant than manganese bronze. Large scale plant test using standard size sheets of each alloy is proposed. CBJp (14b)

Manufacture of Razor Blades (Die Rasierklingen Fabrikation) M. Broich. *Die Metallbörse,* Vol. 23, Aug. 5, 1933, pages 990-991. Steel employed usually contains 1.25-2.40% C and 0.4-0.5% Cr. Cheaper grades do not include Cr. High-grade British blades have 10% Cr and a low amount of Co. The rolling, bright annealing, punching, continuous quenching from 750°-850° C., drawing at 170°-200° C, cleaning, labelling, grinding, polishing, finishing, inspecting and packing operations are taken up in full detail. EFp (14b)

Rustless Steel Conveyors—Their Availability, Application and Use. Nixon W. Elmer. *Transactions American Society of Mechanical Engineers,* Vol. 55, Materials Handling Section, Mar. 31, 1933, pages 17-20. Corrosion resistant materials used for material handling devices are reviewed and their comparative costs tabulated, their good and bad features, types of conveyors, etc., discussed. Particular reference is made to cases where food products have to be handled. Hap (14b)

Application of Nickel-Iron Alloys in Modern Transformers (Ueber die Anwendung von Nickeleisenlegierungen bei neuzeitlichen Stromwandern) B. Hague. *Electrotechnik und Maschinenbau,* Vol. 51, Apr. 2, 1933, pages 208-211. The requirements of transformer iron for laboratory, instrument and industrial transformers, and the properties of modern Fe alloys with respect to them are discussed. In the place of formerly used Si irons Ni-iron is now used, especially for instrument transformers as the required magnetic flux can be produced with about 1/6 to 1/10 of the amp. turns required for Si-Fe and also the losses are much smaller. Most used alloys are Hypernik with 50% Ni, 50% Fe, and the Permalloys with 78.5 Ni, 21.5 Fe. Figures for maximum permeability and losses are given and arrangement of exciting windings described. 15 references. Ha (14b)

Dinking Dies and Their Uses. Chester B. Lord. *American Machinist,* Vol. 77, Mar. 29, 1933, pages 208-210. Dinking dies or clicking dies are used in the manufacture of leather goods (gloves, saddles, etc.) and are sometimes of very intricate shape. It is described how they can be made by welding; a good steel for this purpose has 0.50 C, 0.65 Mn, 0.25 Si, 0.70 Cr and 0.35 Mo. Ha (14b)

Development and Use of Roofing Nails. A. J. Deniston, Jr. *Sheet Metal Industries,* Vol. 7, Aug. 1933, pages 229-230. Taken from a paper presented to the Structures Division of the American Society of Agricultural Engineers. The author closes with 10 recommendations chief of which is that a hot-galvanized nail should always be used. Others deal with the length and number of nails to be used. AWM (14b)

Designing with Two-Ply Stainless. S. L. Ingersoll. *Product Engineering,* Vol. 4, Apr. 1933, page 134. This material is rolled from a composite ingot of any mild steel with a stainless steel on one side; the ratio of thickness between the 2 remains the same during rolling. The material is used best where an unbroken clad surface is exposed to corrosion, heat or abrasion. It can be welded by gas or electric methods. Polishing the mild steel side or a low temperature enamel coating will give some degree of protection to this side. A number of practical applications are enumerated. Ha (14b)

Structural Material for Boiler Water and Air Preheaters (Baustoffe für Speisewasser- und Luftvorwärmer) O. Nürnberger. *Die Wärme,* Vol. 56, Aug. 5, 1933, pages 501-503. Paper before the Rheinisch-Westfälische Dampfkessel-Überwachungsvereine 1933, deals with the various grades of high-grade cast irons and their utilization for the special purpose discussed. Microphotographs are presented. EF (14b)

Selection and Design of Wire Winding Ropes. Henry D. L. Lloyd. *Mechanical World & Engineering Record,* Vol. 93, Sept. 22, 1933, pages 919-921. Discussion of reasons for factor of safety. A safe guide is to limit the diameter of the outer wires of the strands in all constructions. Flexibility is ensured and bending stresses limited by proportioning the size of wire to the drum or sheave diameter. The total stress due to load and bending must be kept within the limits of fatigue stress for high tensile wires, while the choice of tensile strength is largely a matter of cost. The effect which the angle of lay has upon the relation between the aggregate and actual breaking load of the rope is discussed and illustrated. Stress-strain diagrams are given of actual ropes in the various groups. Kz (14b)

Wire Winding Rope Construction. Henry D. L. Lloyd. *Mechanical World & Engineering Record,* Vol. 93, Sept. 29, 1933, pages 936-937. The 5 main groups of rope construction are discussed and illustrated by examples. It is pointed out that new construction makes it possible to provide about 10% increase in tensile strength, with nearly 5% less weight, as compared with the same diameter in the older construction. Kz (14b)

Cast Iron Pipe and Fittings for Sewer Connections. H. R. Devilbiss. *Water Works & Sewerage,* Vol. 53, May 1933, pages 171-173. Observations have shown that cast iron fittings and pipe for house connections to sewers give full satisfaction and are cheaper in first cost and maintenance than terracotta or other more expensive materials. Joints are preferably made with leadite, mineralead, sulphur compound and lead, etc. Ha (14b)

Steel Sheetpile Jetty at Pensacola. Edgar K. Foster & Donald E. Young. *Engineering News-Record.* Vol. 111, Oct. 26, 1933, pages 489-491. Steel sheeting was used for 1,300-ft. jetty to prevent shoaling in Pensacola Bay, Fla., a link of the Intracoastal Waterway. CBJ (14b)

Austenitic Stainless Steels and Their Applications. (Les applications des aciers inoxydables austenitiques.) *Revue du Nickel,* Vol. 3, July 1932, page 119-125. A review of the uses of stainless steels. AH (14b)

Manufacture of Piles from Used Pipe. (Fabrication de pilotis avec des tuyaux usagés.) *Le Soudeur-Coupeur,* Vol. 12, May 1933, pages 9-10. Fabrication of tubular piles from old oil pipe line by means of arc welding. RRS (14b)

Beer Rumblings Awaken Interest in Chrome-Nickel Steel for Breweries. *Steel,* Vol. 91, Dec. 26, 1932, page 21. The return of beer offers a field for the use of Cr-Ni stainless steel for barrels, kegs, tank cars, vats, tanks, coils, etc. Beer may be produced in stainless steel vessels and pasteurized and stored in stainless steel containers as there is no visible effect on either the metal or the beer. JN (14b)

Enameled Sheets Offer Advantages for Small Steel Buildings. *Steel,* Vol. 91, Nov. 21, 1932, pages 23-25. Sheet steel for houses is completely fabricated before being enameled. Enameled sheets are assembled with bolts and screws. Rivets are not used and welding cannot be done without injury to the enamel. Advantages are high salvage value, ease of cleaning, and wide range of coloring and decorative effects. JN (14b)

Hope for Steel Construction Lies in New Markets. *Steel,* Vol. 91, Oct. 24, 1932, pages 33, 35. Résumé of papers presented at the 10th annual convention of the American Institute of Steel Construction, Pittsburgh, Pa., Oct. 20-21, 1932. JN (14b)

Mobile Mooring Mast Presents Many New Problems. *Steel,* Vol. 91, Oct. 17, 1932, pages 28, 30, 32. Description of construction and operation of telescopic, mobile mooring mast for large dirigibles recently completed at U. S. Naval Air Station, Lakehurst, N. J. JN (14b)

GENERAL (15)

RICHARD RIMBACH, SECTION EDITOR

Little Known Properties of Metals (Wenig bekannte Eigenschaften der Metalle) E. Raub. *Mitteilungen des Forschungsinstituts und Probieramts für Edelmetalle,* Vol. 7, Aug./Sept. 1933, pages 51-55. Exhaustive tests show that metals are soluble in ordinary drinking water in very small amounts but that no hygienic harm results from this fact and food can be prepared safely in them. Metals are always hygienically clean even when dirt or food particles cover them; no bacteria can develop on the food particles on silver cutlery for instance. The same fact becomes obvious that coins do not carry infections. The small amount of metal in a solution has a germicidal effect. Ha (15)

Steel Progress. Eric N. Simons. *Electrical Review,* Vol. 113, Oct. 27, 1933, pages 585-586. Discusses some advances of interest to the electrical industry. A new method for manufacturing very light and intricate steel castings has made possible their use for switch-gear. Small stainless steel castings can now be obtained with excellent surface, satisfactory shape, and freedom from pitting. T. Mishima has discovered a new Ni-Al magnet steel. Plating of steel rubber molds first with Cu and then Cr allows use of cheaper steels. Nitriding is used for hardening finished machined parts. For working synthetic materials, 3 steels have been evolved: a W-Cr-Mn steel with high C and a small amount of Si; Cr-Si-Mn steel with occasionally a little Mo; and a Co-Si-Mo steel with high C and small proportion of Mn. Cutting tools are now being used which are made of super-high-speed steel ends welded on to high-grade steel shanks. A file with teeth cut like the arc of a circle has been developed for bakelite and similar materials. MS (15)

The National Physical Laboratory. *Engineering,* Vol. 136, July 28, 1933, pages 95-97; Aug. 4, 1933, pages 121-123; Aug. 11, 1933, pages 147-149. Review of some of the researches now being carried out in the Laboratory. These include fatigue tests, and tests on electric welding, gases in metals, films on molten metals, mechanical properties of materials at high temperatures, work on Mg, Cu, Be, and dental amalgams as well as tests on various ferrous materials for use at high temperatures. LFM (15)

Electrochemistry and Electrometallurgy—1932-33. *Electrical Engineering,* Vol. 52, Oct. 1933, pages 706-707. Developments during this year in the fields of high-temperature steel-treating furnaces, production of Li, electrical precipitation and better control of temperatures and processes are briefly reviewed. Ha (15)

A.S.T.M. Manual on Presentation of Data. (Sponsored by) Committee E-1 on Methods of Testing. American Society for Testing Materials, Philadelphia, 1933, Paper, 6 x 9 inches, 48 pages. Price 50c. Some of the principles of efficient presentation of data are correlated by statistical experts and made available in convenient form with a profusion of tabular and graphic illustrations and of references to comprehensive treatments of topics dealt with. With the exception of a series of tests of 270 bricks (purposely included to exemplify extreme variations) the Manual would seem to have been written for *Metals & Alloys'* readers—and for some metallurgical writers. M. F. Béhar (15)-**B**-

Nickel from Aluminum? (Nickel aus Aluminium?) *Aluminium,* Vol. 15, June 30, 1933, page 6; July 15, 1933, page 7. The transformation of Al atoms into Ni atoms is announced by 2 German chemists without giving any details. This would mean the commutation of a lighter element (Al-27) into a heavier one (Ni-58.7) which sounds improbable as all scanty results obtained so far with transmutations of elements were from heavier to lighter atoms. In an additional note it is said that Ni was found by a commission investigating the process in which Al and an "auxiliary element," both free of Ni and Fe, were used. Ha (15)

The Work of the National Bureau of Standards in Chemistry and Metallurgy. Edw. W. Washburn. *Scientific Monthly,* Vol. 37, July 1933, pages 20-30. Describes and reviews the work done in the different fields of industrial research and physical and metallurgical chemistry. Ha (15)

The Position of Iron in the Metallurgy of the White Metals. E. R. Thews. *Metal Industry,* London, Vol. 43, Oct. 13, 1933, pages 367-368, 376. The rules governing the actions of Fe on binary and ternary white metal alloys are discussed. Fe having a greater affinity for As than for Sb, Sn and Pb, is used for removing As. Fe-As compounds can be broken up by S to which its affinity is still greater and Fe-S compounds again by O. Cu ores can be partly decomposed by metallic Fe: $3Cu_2S + Fe = 2Cu_2S + FeS + Cu_2$. The affinity of Fe for Sb is utilized in reverberatory furnaces for the treatment of white metals containing Fe, As and Sb by forming speiss. Fe-Sn compounds are formed only where Sn is present in large excess (refining of work tin or in smelting Sn ores). Fe does not combine with Pb except to a limited extent in the presence of S. Fe and Cu combine in presence of S and As. In liquating white metals Fe tends to aid in the separation of metallic Cu. If a mixture of Fe, Cu, As, Pb, Sn and Sb in normal proportions is subjected to a liquation or segregation process most of Sn and Sb is taken up by Pb while As and a small percentage of Sb combine with corresponding percentages of Fe. Most of the Cu passes into the residue. If sufficient Fe is present the amount of Cu remaining in the white metal amounts to 0.20 to 0.50% depending on speed of liquation or segregation. Ha (15)

Research in the Metal-Working Industry Not Depressed. Maurice Holland & William Spraragen. *Iron Age,* Vol. 131, Jan. 12, 1933, pages 102-103, adv. sec. page 12. Gives results of survey conducted by the authors. Results show that for the machinery industry 42.2% of companies reporting spent more on research in 1931 than 1929, 31.6% made no change and only 26.2% decreased their expenditures. In machinery industry major emphasis in 1931 was in the development of new products, although a large portion indicated improvement in quality of product. In metal industry only 3 out of 15 reported development of new product, while 10 companies emphasized improvement in quality. VSP (15)

Special Nature of Italian Metallurgical Magazines. Correspondence from Federico Giolotti. *Metal Progress,* Vol. 22, Sept. 1932, pages 51-52. Common knowledge of foreign languages among Italian technicians accounts for the limited number of foreign works translated into Italian. Of 9 magazines in this field, only 2 are devoted exclusively to metallurgy, principally to articles concerning finishing operations. Recently a new magazine on light metals was founded. WLC (15)

Review of Iron and Steel Literature for 1932. E. H. McClelland. *Blast Furnace & Steel Plant,* Vol. 21, Jan. 1933, pages 40-42; Feb. 1933, pages 110-113. 16th annual classified list of the more important books, serials, and trade publications of the year, with a few of earlier date not previously announced. List has been reprinted by the Carnegie Library of Pittsburgh and may be obtained free at the Library or for 5 cents, postpaid. MS (15)

Report, Ontario Research Foundation, for 1932. *Sessional Paper* No. 46, 1933, *Legislative Assembly of Ontario,* 39 pages. Covers, among the other activities, those of the department of metallurgy. The 3 members of this department visited 154 plants and answered 193 inquiries in 1932, beside holding colloquia with foundrymen and studying malleability of steel, heat-treatment of high speed steel, study of sponge iron production from Ontario ores, and various mathematical studies. HWG (15)

Proving the New Product by Pre-Testing. G. L. Curtis. *Executives Service Bulletin* of Metropolitan Life Insurance Co., Vol. 10, Sept. 1932, pages 7-8. Describes elaborate research, laboratory tests and service tests in 23 States preceding introduction of metal window unit. MFB (15)

Non-Ferrous Metallurgy in 1931. Sam Tour. *Mining & Metallurgy,* Vol. 13, Jan. 1932, pages 41-46; Feb. 1932, pages 84-85. A well-digested compendium of advances in this field during the year including the activities of various technical societies and publications in the field. VSP (15)

The Principles of Metallurgy. Donald M. Liddell & G. M. Doan. McGraw-Hill Book Company, New York, 1933. Cloth, 6 x 9¼ inches, 626 pages. Price $5.50. This textbook is unusual in that it aims to cover both preparation metallurgy (ore concentration, smelting and refining), and physical metallurgy, in one volume. The sections on preparation metallurgy are written from the engineering point of view, with consideration of economic suitability of different methods and processes. These sections are overwhelmingly non-ferrous, for, while ferrous processes are discussed, the space devoted to them is not consistent with their economic importance or with the relative numbers of metallurgists in the two branches of the industry.

The physical metallurgy sections are written more from the theoretical than the engineering or economic point of view. Phase rule diagrams and much on crystal structure as shown by X-ray methods get plenty of space while many things that worry metallurgists in practice, such as corrosion, fatigue failure, high temperature properties, machineability, are very briefly dismissed. Heat-treatment, carburizing, precipitation-hardening principles and applications also seem very sketchily dealt with.

One of the stated objects of the book is to give the engineering student who is not to take up metallurgy as a life work a general view of the subject. If this is to effectively be accomplished it would seem necessary to deal with metallic products much more from the user's point of view.

The other purpose, to give the metallurgical student himself a proper foundation, is better accomplished, since the book would be a good introduction to more intensive and specialized courses.

The subjects covered are too extensive for the volume to be very helpful as a reference book on any given detail. It is a good textbook for the metallurgical student, but to make the "general engineering student who will not require more than a general background of the subject" try to absorb a great deal of the material in the book is cruelty to animals. We have no quarrel with the book, it is a front-rank metallurgical textbook, but we think that engineers other than practising metallurgical engineers need a quite different type of text, one in which the properties of metals and alloys are discussed and metallurgical principles invoked to show how these properties are obtained.

Some of the chapter titles are ores, slags and fluxes, refractories, fuels, air and water supply, pyro, hydro and electrometallurgy, sampling, dust and fume control, temperature measurement, metallic state, alloys, structure and properties, shaping technology. H. W. Gillett (15)-**B**-

Agenda Dunod 1934—Mines. Agenda Dunod 1934—Metallurgie. Dunod, Paris, 1934. Fabrikoid, 4 x5¾ inches, 343 and 345 pages, respectively. Price 20 Fr. each. In reviewing yearly editions of these little handbooks almost a stencil can be used. Typically French in their make-up and presentation they differ from volume to volume so slightly that any comments are superfluous. The same mistakes and the same pleasing features repeat themselves with the steadiness of seasons. A few pages subtracted from this or added to that chapter is all that can be mentioned. J. D. Gat (15)-**B**-

Directory of Iron, Steel and Non-Ferrous Alloys. Johnson Publishing Company, Cleveland, 1933. Paper, 5½ x 8 inches, 30 pages. Price 25 cents. This booklet, which was published as a supplement to the September 1933 issue of Machine Design, lists the alloys alphabetically by trade name and classifies them as to properties. Blank spaces in the directory are provided for the addition of new names which will be announced from time to time. M. L. Moorman (15)-**B**-

A.S.T.M. Standards (issued triennially) **1933. Part I, Metals.** American Society for Testing Materials, Philadelphia, 1933. Cloth, 6 x 9 inches, 1002 pages. Price $7.50. Since the last edition, some two dozen of the older standards have been discontinued and replaced by new ones. A total of 55 of the 185 standards for metals had final revision and adoption in 1933. The "tentative" standards that are going through the mill of discussion and trial appear in other publications of the society but not in this volume which deals solely with fully matured standards.

The specifications cover dimensions, composition, properties and methods of mechanical and magnetic testing of alloys for a wide variety of uses, while standard methods for chemical analysis, and recommended practices for thermal analysis, radiographic testing, preparation of micrographs are given, as well as definitions of terms used.

Grain size charts for steels and annealed brass are included as inserts. H. W. Gillett (15)-**B**-

Chemical Engineering Catalog. 18th Annual Edition. Chemical Catalog Co. Inc., New York, 1933. Cloth, 8½ x 11¼ inches, 789 pages. Price $10, except to special classes of technical men to whom it is lent gratis or sold for $3. Fortunately, the Chemical Engineering Catalog remains essentially the same from year to year, for, if its plan varied materially the convenience of using it frequently would be lost. Its three major indexes lead one easily to sources and descriptions of plant equipment, raw materials and books conveniently listed in three corresponding sections. The trade name list completes this useful compilation of manufacturers' catalogs in a form readily reached and difficult to lose in even a busy plant. Despite a shrinkage in size, the catalog still continues the most useful tool in the plant manager's kit. D. H. Killeffer (15)-**B**-

The Handbook of Chemistry and Physics. Chas. D. Hodgman, Editor-in-Chief. Chemical Rubber Publishing Co., Cleveland, 1933. Fabrikoid, 4¼x6½ inches, 1818 pages. Price $6.00. The handbook represents a 20-year accumulation of data with constant revision, year by year, bringing it up-to-date. This new edition contains 220 pages of mathematical tables and formulae; 800 pages of chemical tables including the physical constants of 4000 organic compounds and 4000 inorganic and metal-organic compounds; 44 pages on properties of matter; 135 pages on heat; 54 pages on sound, electricity and magnetism; 204 pages on light; 134 pages of measures and units.

The table of physical constants of inorganic compounds has been completely revised and about a thousand new compounds have been added. The metal-organic compounds have been placed in a separate table. The following tables have been revised and enlarged: pH Values for Potentiometer Readings; Organic Analytical Reagents; Optical Rotation of Acids and Bases; Solubility Chart and Musical Scales. The following new tables have been added: Volumetric Primary Standards; Efficiency of Drying Agents; Liquids for Index by Immersion Method and Density of Fluosilicic Acid Solutions. Richard Rimbach (15)-**B**-

National Metals Handbook. 1933 Edition. American Society for Steel Treating, Cleveland, Ohio, 1933. Cloth, 4x7 inches, 1453 pages. Price to non-members of A.S.S.T. $10.00. The National Metals Handbook is published in revised and enlarged form every 2 or 3 years. The handbook consists of a number of articles on subjects having the most extensive use, classified under 7 major headings: General and miscellaneous data; the constitution of matter; structure; properties; testing; technology; and application. Richard Rimbach (15)-**B**-

Industrial Research Laboratories of the United States Including Consulting Research Laboratories. Compiled by Clarence J. West & Callie Hull. Bulletin 91, National Research Council, Washington, D. C., 1933. Paper, 6¾x9¾ inches, 223 pages. Price $2.00. The material is that furnished by the directors of the laboratories and is considered correct as of January 1, 1933. Laboratories connected with federal, state, or municipal governments or with educational institutions were excluded though they may frequently be engaged upon investigations of industrial problems. Most concerns which are not actually supporting laboratories in their own plants have not been included, nor have most of the associations maintaining fellowships in educational institutions. This compilation is limited to the laboratories themselves. The bulletin contains information on 1575 industrial consulting laboratories. Richard Rimbach (15)-**B**-

Economic (15a)

Mine Production of Gold, Silver, Copper, Lead, and Zinc in Oregon in 1932, by Counties. Charles W. Merrill. *United States Bureau of Mines, Mineral Market Reports* No. M. M. S. 228, Sept. 7, 1933, 1 page. Total value of Au, Ag, Cu, Pb and Zn produced in Oregon in 1932 was $415,627, as compared with $319,703 in 1931. AHE (15a)

Production of Gold, Silver, Copper, Lead, and Zinc in California in 1932. Charles W. Merrill. *United States Bureau of Mines, Mineral Market Reports* No. M. M. S. 231, Oct. 30, 1933, 2 pages. Total value of Au, Ag, Cu, Pb, and Zn produced in Calif. in 1932 was $12,066,750, a small drop from the $12,387,734 output in 1931. AHE (15a)

Mine Production of Gold, Silver, Copper, Lead, and Zinc in Nevada in 1932, by Counties. Charles W. Merrill. *United States Bureau of Mines, Mineral Market Reports* No. M. M. S. 227, Sept. 7, 1933, 1 page. The total value of Au, Ag, Cu, Pb and Zn production in Nevada in 1932 was $5,067,171 as compared with $11,673,787 in 1931. AHE (15a)

Lead Industry in 1933—Advance Summary. H. M. Meyer. *United States Bureau of Mines, Mineral Market Reports* No. M. M. S. 253, Jan. 12, 1934, 2 pages. Refined Pb produced in the United States from domestic ores in 1933 totaled 252,500 tons, a decrease of 1% from 1932, a new low since 1899. Refined primary Pb produced from foreign sources (13,900 tons) was less than ½ that in 1932 (33,024 tons) and less than any year since 1886. Recovery of secondary Pb at primary plants (46,300 tons) increased until the total output of refined Pb at primary plants (321,972 tons) was only 3% less than 1932. The calculated new supply of Pb was 9% lower than in 1932. AHE (15a)

Zinc Industry in 1933—Advance Summary. H. M. Meyer. *United States Bureau of Mines, Mineral Market Reports* No. M. M. S. 250, Jan. 5, 1934, 2 pages. Primary metallic Zn from domestic and foreign sources in 1933 was nearly 49% higher in 1933 than in 1932 and 5% more than 1931. Apparent deliveries to domestic consumers were about 58% higher than 1932. Stocks were reduced about 23%, 41% from the record high. Output of primary metallic Zn from domestic ores was about 307,200 short tons. AHE (15a)

Copper Industry in 1933—Advance Summary. H. M. Meyer. *United States Bureau of Mines, Mineral Market Reports* No. M. M. S. 256, Jan. 18, 1934, 3 pages. Smelter output of Cu from domestic ores in 1933 was about 477,000,000 lbs. as compared with 544,009,948 lbs. in 1932. Primary and secondary output of Cu was about 906,300,000 lbs., an increase of 13% over 1932. Imports decreased 30%. Stocks declined 12%. AHE (15a)

Survey of the World Graphite Situation. Benjamin L. Miller. *Mining & Metallurgical Society of America Bulletin* No. 226, Vol. 26, Dec. 1933, pages 101-112. General. AHE (15a)

Metal Mining in Montana, 1933—Advance Summary. T. H. Miller & Paul Luff. *United States Bureau of Mines, Mineral Market Reports* No. M. M. S. 243, Jan. 12, 1934, 3 pages. Output of Au, Ag, Cu, Pb and Zn in Montana in 1933 increased $1,612,843 in value over 1932 to $8,469,580. AHE (15a)

Production of Gold, Silver, Copper, and Lead in Arizona in 1932, by Counties. C. N. Gerry. *United States Bureau of Mines, Mineral Market Reports* No. M. M. S. 235, Nov. 4, 1933, 1 page. The value of Au, Ag, Cu, and Pb produced in Arizona in 1932 was $13,535,935, as compared with $40,144,694 in 1931. Au output declined almost 50%, from 126,185.94 oz. to 66,789.67 oz., Ag from 3,245,311 oz. to 2,082,823 oz., and Cu from 401,344,909 to 182,491,825 lbs. Pb production increased from 1,964,112 to 2,364,300 lbs. AHE (15a)

Ore Consumption Cut by Scrap; Exceeds Shipments. *Steel,* Vol. 92, Jan. 30, 1933, pages 11, 51. Lake Superior iron ore shipments in 1932 amounted to 3,588,608 gross tons, and consumption, to 9,837,000 gross tons. Only 1.4 tons of ore were consumed in making a ton of pig-iron, compared with a 10-year average of 1.78 tons. The reason was the larger proportionate use of scrap and flue-dust. Includes chart showing Lake Superior ore consumed per ton of pig-iron produced for 1921-32 and tables of total tonnage shipped and consumed for 1929-32, and shipments by mines in 1931 and 1932. MS (15a)

Construction Progress at the Pretoria Steelworks. *South African Electrical Review and Engineer,* Vol. 24, July 1933, pages 17-19. Brief description of the plant and estimates of capital costs. RRS (15a)

Our Expanding Steel Industry. *South African Electrical Review & Engineer,* Vol. 23, Sept. 1933, pages 21, 23. Hollow drill steel is produced in Heroult furnaces at the Vereinigung Works of the United Steel Corporation. RRS (15a)

The Steel Cartel. *Engineer,* Vol. 155, May 12, 1933, page 481; June 9, 1933, page 575. Reviews the difficulties encountered from the time the Cartel was created in 1926. The experiment failed due to outside competition and because various steel makers in some of the countries refused to cooperate. A new arrangement has now been made. Each country is allotted a quota based on steel exports during the first half of 1932. To Belgium is allotted 29% of the steel exports, Germany and the Saar 29%, France 21% and Luxembourg 21%. There is no restriction of steel output. Each country may produce all that is necessary for home needs but it must not sell more than the allotted amount outside the country. LFM (15a)

Tariffs and the Steel Industry. *Engineer,* Vol. 155, June 16, 1933, page 605. From remarks made by Sir John Beale, chairman, to the stockholders of Guest, Keen and Nettlefolds, Ltd., shortly after the opening of the Economic Conference in London. He expected drastic changes in the conditions in the iron and steel industry of Great Britain. LFM (15a)

The Iron and Steel Industry. *Engineer,* Vol. 155, Apr. 14, 1933, page 374. Reviews the work of the Import Duties Advisory Committee from the time of its first report on April 8, 1932, including its recommendations to the various committees representing the iron and steel industry. See also editorial in *Engineer,* Apr. 14, 1933, pages 377-378. LFM (15a)

American Steel Developments. *Engineer,* Vol. 155, May 26, 1933, page 533. Expansion of the steel producing capacity of the U. S. reached 100,000 tons for 1932 as compared with more than 4,000,000 tons in 1931. Briefly describes new methods being used by various companies. LFM (15a)

Status of World Production of Aluminum (Stand der Aluminium-Weltproduktion) *Aluminium,* Vol. 15, July 1933, pages 5-6. Statistics from 1929-1931 for all Al producing countries. Ha (15a)

18th Annual Review of the Silver Market. The Gold Situation in the Arts and Industries. Handy & Harman, New York, 1933. 51 pages, 3 charts. The history of the U. S. silver situation during 1933 is recorded and charted, and world statistical tables given. Depreciation of the dollar is discussed. Use of silver in arts and industries in the United States and Canada increased some 8% in 1933 over 1932. Larger increases were shown in table ware, photography, chemical equipment and silver solders, while jewelry and dental products showed a decrease. Bi-metallism, which would result in an actual silver standard of coinage, is not expected. Currency stabilization, with elimination of incentive for speculative purchase of silver, is expected. It is not believed that a rise in the price of silver would benefit trade with India and China. The gold situation is similarly discussed. Secondary gold was in sufficient supply for trade requirements in arts and industries, and since October 27, 1933, gold for such purposes has come to industry from dealers, not being obtainable from the government, and its price is established by supply and demand. At the end of the year this price was about half-way between the old statutory rate and the dollar equivalent of the London price. The review is an interesting, dispassionate account of the happenings of a remarkable year in the history of gold and silver. HWG (15a)

Tungsten Industry in 1932—Annual Summary. Frank L. Hess & H. W. Davis. *United States Bureau of Mines, Mineral Market Reports* No. M.M.S. 224, Aug. 15, 1933, 2 pages. In 1932, 396 short tons of domestic concentrated W ore (reduced to equivalent of 60% WO_3) were sold for $218,394, as contrasted with 1,404 tons worth $928,000 in 1931. W imports were 106,202 lbs. (189,276 lbs. in 1931) worth $30,700 ($63,847 in 1931). AHE (15a)

The Buying and Selling of Old Gold. C. M. Hoke. *Metal Industry,* N. Y., Vol. 31, Feb. 1933, pages 55-57. A few pointers are given regarding the handling of old precious metals. PRK (15a)

Cast Iron in Defense and Attack (Der Werkstoff Gusseisen in der Abwehr und im Angriff) Th. Geilenkirchen. *Die Giesserei,* Vol. 20, Oct. 13, pages 453-460; Oct. 27, 1933, pages 481-485. In spite of strong competition by steel castings and welded construction, cast Fe is still the material "par excellence" for many purposes. The main factors to produce good quality are discussed: proper design of shape, molding, casting and composition; a properly handled bookkeeping system should determine accurate cost of production. Ha (15a)

Taxes Grind Iron Ore Industry; Minnesota Refuses Relief. A. J. Hain. *Steel,* Vol. 92, Jan. 3, 1933, pages 75-77. Reviews iron ore tax situation as it exists in Minnesota. Excessive taxation was the major problem of the mine operators in 1932. MS (15a)

The Experiment in Governmental Control of Tin Production. G. Temple Bridgman. *Mining & Metallurgical Society of America Bulletin* No. 226, Vol. 26, Dec. 1933, pages 86-88. The features making for the success of the control of the Sn industry are described. AHE (15a)

Fuel Control in the Iron and Steel Industry. Edgar C. Evans. *Iron & Coal Trades Review,* Vol. 127, Oct. 6, 1933, page 521. Coöperative activities in Great Britain for conservation of fuel, abatement of smoke and related problems are reviewed. See also *Metals & Alloys,* Vol. 1, Aug. 1930, page 684. Ha (15a)

Iron Ore—Home or Foreign. T. H. Burnham. *Iron & Steel Industry & British Foundryman,* Vol. 6, Apr. 1933, pages 235-236. An argument for the use of domestic iron ore at the new steel works erected at Corby. CHL (15a)

Light Metal in Shipbuilding (Leichtmetall im Schiffbau) A. Bunje. *Werft, Reederei und Hafen,* Vol. 14, Sept. 15, 1933, pages 263-264. Pertains to the "Kompositbau" adapted by a leading German ship yard (Luerssen-Vegesack) specializing in fast motor-boats and cruisers. The company widely uses a combination of Duralumin and wood. The author states that a torpedo-boat made of steel and being all welded, would weigh twice as much as the light metal construction. The displacement would increase 20% and the speed drop 6%. An all-light-metal design would prohibit the use of propellers of sea-water resistant bronze due to the occurrence of galvanic currents. WH (14a)

Development of Industrial Electric Heating as a National-Economic Problem (Der Ausbau der industriellen Elektrowärmeanwendung als volkswirtschaftliche Aufgabe) C. T. Buff. *Elektrotechnische Zeitschrift,* Vol. 54, July 6, 1933, pages 653-656. Several examples of electric furnaces in metal and glass industries are illustrated. Ha (15a)

The Necessity of Maintaining a Copper Tariff. Louis S. Cates. *Mining & Metallurgical Society of America Bulletin* No. 226, Vol. 26, Dec. 1933, pages 88-96. General, supported by statistical data. AHE (15a)

Cost Finding to Assure Profits. VIII. Chas. H. Hatch. *American Machinist,* Vol. 77, Dec. 6, 1933, pages 786-788. Methods of cost analysis are discussed. Ha (15a)

General Report of the Geological Survey of India for the Year 1932. L. L. Fermor. *Records of the Geological Survey of India.* Vol. 67, Part 1, 1933, pages 1-82. Current work on coal, Cu, dolomite, Au, Fe, Pb, and Mn is described briefly. AHE (15a)

Some Features of Canada's Position with Respect to Base Metals. Charles Camsell. *Canadian Mining & Metallurgical Bulletin* No. 258, Oct. 1933, pages 589-608. Figures are presented tabularly showing production by provinces, destination of exports, world production and consumption, etc. AHE (15a)

Iron Ore Industry in 1933—Advance Summary. H. W. Davis. *United States Bureau of Mines, Mineral Market Reports* No. M. M. S. 251, Jan. 9, 1934, 3 pages. Fe ore mined in the United States in 1933, exclusive of that containing 5% or more of Mn, was estimated at 17,511,000 tons, an increase of 78% over 1932. Shipments were about 24,608,000 tons, valued at $63,744,000, an increase of 362% in quantity and 394% in value compared with 1932. Stocks were reduced 38%. Increase of av. value at the mines from $2.42 to $2.59 is due partly to Lake Superior ores making up 87% of the total as compared with 67% in 1932. Lake Superior output increased 79% and shipments 501%. AHE (15a)

The Price of Gold and the Prices of Commodities. E. H. Davenport. *Tin,* Oct. 1933, pages 1-4. The international relations of distribution of gold, credit systems and commodity prices are discussed and present conditions considered. Inflationary measures are seen to improve commodity prices in off-gold countries more in percentage than the depreciation of their currencies in terms of gold. Ha (15a)

Manganese Ore Industry in 1933—Advance Summary. H. W. Davis. *United States Bureau of Mines, Mineral Market Reports* No. M. M. S. 258, Jan. 26, 1934, 2 pages. Shipments of domestic ore containing 35% or more Mn in 1933 were approximately 18,500 long tons valued at $447,000, compared with 17,777 tons worth $377,222 in 1932. Shipments of domestic ore containing 10-35% Mn declined from 15,635 to 12,000 tons. Domestic ore shipments of 5-10% grade were 204,000 tons (9,799 tons in 1932). Imports were 152,169 tons containing 76,785 tons of Mn. AHE (15a)

Gold and Silver in 1931. J. P. Dunlop. *United States Bureau of Mines, Mineral Resources of the United States, 1931,* Part 1, Oct. 25, 1933, pages 679-710. Au output in the United States in 1931 was 2,395,878 oz. worth $49,527,200. $2,279,600 more than 1930. Ag production was 30,932,050 oz. worth $8,970,294, $19,816,077 less than in 1930. Leading Au producers were California, Alaska and South Dakota. The chief Ag producers were Utah, Idaho, Montana, and Arizona. AHE (15a)

Metal Mining in Nevada, 1933—Advance Summary. J. B. Knaebel & H. M. Gaylord. *United States Bureau of Mines, Mineral Market Reports* No. M. M. S. 247, Jan. 15, 1934, 2 pages. Au output in Nev. in 1933 decreased from 129,719.83 to about 105,000 oz. Ag production decreased from 1,304,365 to 1,115,000 oz. but the value increased from $367,831 to $384,675. Cu output increased from 31,487,606 lbs. valued at $1,983,719 in 1932 to 38,900,000 lbs. worth $2,489,600. Pb produced increased from 880,986 to 4,731,000 lbs. and the value from $26,430 to $175,047. AHE (15a)

Metal Mining in Oregon, 1933—Advance Summary. J. B. Knaebel & H. M. Gaylord. *United States Bureau of Mines, Mineral Market Reports* No. M. M. S. 248, Jan. 15, 1934, 1 page. The value of Au, Ag, Cu, Pb, and Zn produced in Oregon in 1933 was about $423,500, as compared with $415,627 in 1932. Au production increased from 19,861 to 20,200 oz. Most of the Ag, Cu, Pb, and Zn was recovered in the treatment of Au ores. Ag increased from 8,616 to 13,000 oz., Pb from 7,917 to 10,000 lbs. and Zn from 12,061 to 15,600 lbs. Cu declined from 32,199 to 6700 lbs. AHE (15a)

Minerals Yearbook, 1932-33. O. E. Kiessling, et al. *United States Bureau of Mines,* 1933, 819 pp. $1.25. The first issue of a yearbook replacing Mineral Resources of the United States, published continuously since 1866, annually since 1880. The status of the mineral industries is discussed by Scott Turner. Production for 1932 is given, compared with previous years and discussed for Au, Ag, Cu, Pb, Zn, secondary metals, Fe, Al, Hg, Mg, Mn, Mo, W, Sn, Cr, Sb, As, Ra, U, V, Pt, and allied metals, Ni, minor metals, ore concentration, coal, coke, petroleum, natural gas, and various nonmetallics. Pig Fe suffered the greatest decline. A. H. Emery (15a)-B-

Copper, Lead and Zinc Mining in 1933—Advance Summary. O. E. Kiessling. *United States Bureau of Mines, Mineral Market Reports* No. M. M. S. 259, Jan. 22, 1934, 3 pages. Smelter production of Cu from domestic ores in 1933 was 238,500 short tons and refinery production of new Cu from domestic and foreign ores was 378,100 tons. Output of primary refined Pb from domestic sources was 252,500 tons and from foreign sources 13,900 tons more. Smelter output of primary Zn from domestic ores in 1933 was 307,200 tons, with foreign ores adding 800 tons. AHE (15a)

Silver and Canadian Trade. J. Mackintosh Bell. *Transactions Canadian Institute of Mining & Metallurgy, 1933* (in Canadian Mining & Metallurgical Bull. No. 257, Sept. 1933), pages 431-447. General. 47 references. AHE (15a)

Trade in the Dutch Indies. H. A. N. Bluett. *Iron & Coal Trades Review,* Vol. 127, Aug. 4, 1933, page 166. Report on the economical conditions in the Netherland East Indies including iron and steel imports, the mining, manganese production and coal trade and production in 1932. Ha (15a)

Metal Mining in Utah, 1933—Advance Summary. C. N. Gerry & T. H. Miller. *United States Bureau of Mines, Mineral Market Reports* No. M. M. S. 244, Jan. 12, 1934, 3 pages. Utah mines produced $1,443,603 more Au, Ag, Cu, Pb and Zn in 1933 than in 1932. The total value was $15,842,196. Utah was the only state to increase Cu production, 64,964,111 to 73,046,000 lbs., and raised its position among the states from its usual 3rd to 2nd position. Zn recovery increased from 59,331,888 to 63,235,000 lbs. Pb output decreased from 125,552,966 lbs. in 1932 to 114,762,000 lbs. but the value increased from $3,766,589 to $4,246,194. Au production decreased from 135,256.35 to 108, 841 oz. Ag output decreased from 6,962,097 to 5,658,000 oz. and dropped Utah from 1st position among the states, held since 1920, to 2nd. The value decreased only slightly due to rising Ag prices. AHE (15a)

Metal Mining in Arizona, 1933—Advance Summary. C. N. Gerry & Paul Luff. *United States Bureau of Mines, Mineral Market Reports* No. M. M. S. 241, Jan. 12, 1934, 3 pages. Arizona produced $9,686,178 of Au, Ag, Cu, Pb, and Zn in 1933, a decrease of $3,850,000 from 1932. Au production increased about 12%, 66,789.67 to 75,813 oz., and Ag 20%, 2,082,823 to 2,409,300 oz. worth $587,356 and $831,209. Cu output declined still further, 38% below 1932 and 72% below 1931, from 182,491,825 lbs. in 1932 to 112,500,000 lbs. in 1933 and the value from $11,496,985 to $7,201,600. Pb production was practically the same 2,364,300 lbs. in 1932, 2,300,000 lbs. in 1933, but the value increased from $70,929 to $85,100. Zn output was insignificant. AHE (15a)

Metal Mining in Idaho, 1933—Advance Summary. C. N. Gerry & T. H. Miller. *United States Bureau of Mines, Mineral Market Reports* No. M. M. S. 242, Jan. 10, 1934, 3 pages. The value of Au, Ag, Cu, Pb, and Zn produced from mines in Idaho in 1933 was about $11,211,718, an increase of $3,334,114 over the total value of the metals in 1932. Each of the metals increased in quantity and value. Au output was about 61,208 oz. as compared with 46,885.39 oz. in 1932. Ag production was 7,202,000 oz., 6,716,968 oz. in 1932; value increased from $1,894,185 to about $2,484,690. Cu output increased in amount and value from 1,143,381 lbs. worth $72,033 to 1,464,600 lbs. worth $93,734. Pb production in 1933 was 149,761,000 lbs. valued at $5,541,157 while in 1932 the amount was 144,235,067 lbs. worth $4,327,052. Zn output more than doubled, 20,504,234 to 42,485,000 lbs. and $615,127 to $1,826,855. AHE (15a)

Metal Mining in Washington, 1933—Advance Summary. C. N. Gerry & Paul Luff. *United States Bureau of Mines, Mineral Market Reports* No. M. M. S. 245, Jan. 10, 1934, 2 pages. The value of Au, Ag, Cu, Pb, and Zn produced from mines in Washington in 1933 was about $487,211, compared with $300.263 in 1932. Pb output increased 369,000 lbs. and Zn 2,500,000 lbs. Cu production was practically the same. AHE (15a)

Gold, Silver, Copper, Lead, and Zinc in Idaho in 1932, by Counties. C. N. Gerry. *United States Bureau of Mines, Mineral Market Reports* No. M. M. S. 229, Sept. 27, 1933, 1 page. The production of Au in Idaho in 1932 was 46,885.39 oz., 18,361.36 oz. in 1931; Ag in 1932 was 6,716,968 oz., 7,220,923 oz. in 1931; Cu declined only slightly from 1,144,915 lbs. to 1,143,381 lbs.; Pb in 1932, 144,235,067 lbs., declined from 198,729,228 lbs.; Zn output in 1932 was 20,504,234 lbs, 39,137,212 lbs. in 1931. AHE (15a)

Production of Gold, Silver, Copper, Lead, and Zinc in Montana in 1932, by Counties. C. N. Gerry. *United States Bureau of Mines, Mineral Market Reports* No. M. M. S. 232, Oct. 30, 1933, 1 page. Value of output of Au, Ag, Cu, Pb, and Zn in Mont. in 1932 was $6,856,737, as compared with $19,575,053 in 1931. Au only increased from 40,112.16 to 40,602.01 oz. Ag decreased from 3,829,837 to 1,686,213 oz., Cu from 184,555,735 to 84,847,349 lbs., Pb from 8,860,186 to 2,157,766 lbs. and Zn from 13,494,986 to 4,393,034 lbs. AHE (15a)

Gold, Its Sources and Production. Robert Annan. *Mining Journal,* Vol. 183, Nov. 11, 1933, pages 778-779. General. AHE (15a)

Some Aspects of the Luxemburg Iron Industry. K. C. Edwards. *Iron & Coal Trades Review,* Vol. 127, Sept. 29, 1933, page 476. Review of its development, its importance in spite of its smallness. The economic relations with other countries are explained. Ha (15a)

Silver Mine Production in the Western States and Alaska, 1933—Advance Summary. Chas. W. Henderson. *United States Bureau of Mines, Mineral Market Reports* No. M. M. S. 255, Jan. 18, 1934, 2 pages. Thirteen western states in 1933 yielded 22,895,066 oz. of Ag as compared with 22,402,598 oz. in 1932. Eight increased output over 1932. AHE (15a)

Metal Mining in New Mexico, 1933—Advance Summary. Chas. W. Henderson. *United States Bureau of Mines, Mineral Market Reports* No. M. M. S. 249, Jan. 15, 1934, 2 pages. Au production in New Mexico in 1933 increased from 23,208 to 25,964 oz. Ag output in 1932 of 1,142,351 oz. was raised to 1,186,132 oz. in 1932. Pb production of 21,537,000 lbs. in 1933 compared favorably with 20,227,000 lbs. in 1932. Zn production increased from 51,186,000 to 62,729,000 lbs. Cu alone decreased, from 28,419,000 to 27,264,000 lbs. AHE (15a)

Metal Mining in Colorado, 1933—Advance Summary. Chas. W. Henderson. *United States Bureau of Mines, Mineral Market Reports* No. M. M. S. 238, Jan. 9, 1934, 6 pages. The 1933 output of certain metals in Colorado was Au 242,008 oz., Ag 2,242,646 oz., Pb 4,510,000 lbs., Cu 9,948,000 lbs. and Zn 2,491,000 lbs. Au decreased from 317,928 oz. in 1932; all others increased, Ag from 1,860,408 oz., Pb from 4,299,000 lbs., Cu from 7,398,000 lbs., and Zn from 218,000 lbs. AHE (15a)

Gold Mine Production in the Western States and Alaska, 1933—Advance Summary. Chas. W. Henderson. *United States Bureau of Mines, Mineral Market Reports* No. M. M. S. 254, Jan. 17, 1934, 3 pages. Thirteen Western States in 1933 yielded 1,799,597 oz. of Au as compared with 1,835,103 oz. in 1932. Alaska's output in 1933 was 520,418 oz. as compared with 493,860 oz. in 1932. AHE (15a)

Gold, Silver, Copper, Lead, and Zinc in Nevada in 1931. V. C. Heikes. *United States Bureau of Mines, Mineral Resources of the United States, 1931,* Part 1, Aug. 1933, pages 601-632. The output of Au, Ag, Cu, Pb, and Zn from Nev. mines in 1931 was valued at $11,673,787, a decrease of $9,781,730 from 1930. Au production decreased from 149,064.47 oz. to 142,293.76 oz., Ag from 4,219,832 oz. to 2,562,071 oz. (value $1,624,635 to $743,001), Cu from 109,203,512 lbs. to 72,634,497 lbs. and from $14,196,457 to $6,609,739, Pb from 23,058,381 lbs. to 15,860,634 lbs. worth $1,152,919 and $586,843 respectively, and Zn from 29,168,117 lbs. to 20,861,348 lbs. valued at $1,400,070 and $792,731, respectively. AHE (15a)

Mine Production of Gold, Silver, Copper, Lead, and Zinc in Colorado in 1932, by Counties. Chas. W. Henderson. *United States Bureau of Mines, Mineral Market Reports* No. M. M. S. 233, Oct. 30, 1933, 2 pages. Output of Au, Ag, Cu, Pb and Zn in Colorado in 1932 decreased from $7,942,154 to $7,698,373. Au production increased from $4,822,734 to $6,572,154; Ag declined from $636,815 to $524,635; Cu from $743,015 to $466,074; Pb from $509,416 to $128,970 and Zn from $1,230,174 to $6,540. AHE (15a)

Metal Mining in Wyoming, 1933—Advance Summary. Chas. W. Henderson. *United States Bureau of Mines, Mineral Market Reports* No. M. M. S. 240, Jan. 10, 1934, 1 page. The estimated recovery of metals from Wyoming mines in 1933 was Au 2,203 oz. and Ag 259 oz., compared with 1932 production of Au 257 oz., Ag. 195 oz., Pb 9800 lbs., and Cu 397 lbs. AHE (15a)

Gold, Silver, Copper, Lead, and Zinc in California in 1931. V. C. Heikes. *United States Bureau of Mines, Mineral Resources of the United States, 1931,* Part 1, Oct. 31, 1933, pages 633-665. Output of Au, Ag, Cu, Pb, and Zn from California in 1931 was valued at $12,387,734, a decrease of 10% from 1930. Au, Pb and Zn increased in quantity; Ag and Cu decreased substantially. AHE (15a)

The Non-Ferrous Metal Manufacturing Industries of Australia. Clement Blazey. *Chemical Engineering & Mining Review,* Vol. 26, Oct. 5, 1933, pages 29-33. A brief review of the principal mills conducting the drawing, rolling, and extruding of non-ferrous metals. WHB (15a)

Iron and Steel Trade with the Argentine. S. G. Irving. *Iron & Coal Trades Review,* Vol. 127, July 38, 1933, pages 132-133. A summary of the economic conditions of Argentina with particular reference to steel industries and relations between Great Britain and Argentina. Ha (15a)

Gold, Silver, Copper, Lead, and Zinc in Oregon in 1931. V. C. Heikes. *United States Bureau of Mines, Mineral Resources of the United States, 1931,* Part 1, Oct. 31, 1933, pages 667-677. The value of mine production of Au, Ag, Cu, and Pb in Oregon in 1931 was $319,703, only 2% less than in 1930. Both quantity and value of every metal except Au decreased—Cu 99% in both quantity and value. Pb 62% in quantity and 72% in value and Ag 19% in quantity and 39% in value. Au, increasing from 14,401.34 oz. to 15,350.10 oz., offset most of this decline. AHE (15a)

Metal Mining in California, 1933—Advance Summary. J. B. Knaebel & H. M. Gaylord. *United States Bureau of Mines, Mineral Market Reports* No. M. M. S. 246, Jan. 16, 1934, 3 pages. The value of Au, Ag, Cu, Pb, and Zn produced in California in 1933 was $12,473,351, as compared with $12,066,750 for 1932. Output of Au increased from 569,167 to 592,400 oz. Ag production decreased from 493,533 to 352,700 oz. in 1933; increased price of Ag made the decrease in value proportionally less. Cu output was 1,145,000 lbs. valued at $73,280; in 1932 it was 1,417,876 lbs. worth $89,326. Pb decreased from 2,417,416 lbs. valued at $72,522 in 1932 to 703,500 lbs. valued at $26,030 in 1933, the lowest output since 1907. No Zn was produced in 1932. AHE (15a)

Uniform Cost Accounting for Forgings (Richtlinien für die einheitliche Vorrechnung von Schmiedestücken) H. Euler & K. Rummel. *Archiv für das Eisenhüttenwesen,* Vol. 7, July 1933, pages 67-79. Calculations for the various items of cost and typical cost record sheets are illustrated. SE (15a)

Weak Points of the U.S.S.R. Geological Survey in Relation to Non-Ferrous Metals. M. P. Rusakov. *Tzvetnuie Metallui,* No. 3, Mar. 1932, pages 406-417. (In Russian.) Points out the deficiencies in the U.S.S.R. Geological Survey work for exploration of the deposits of non-ferrous metals, and gives suggestions for improvements necessary to enable the state to fulfill the non-ferrous metal requirements outlined in the second 5-year plan. BND (15a)

The Electro-Chemical and Metallurgical Industries of Norway. O. W. Roskill. *Chemical Age,* Vol. 26, June 4, 1932, pages 513-514. Review of history and present capacity of Norwegian plants for production of electric power, Al, Zn, Ni, carbide and atmospheric nitrogen fixation. VVK (15a)

Statistical Review of Ontario's Mineral Industry in 1931. W. R. Rogers & A. C. Young. *Annual Report, Ontario Department of Mines,* Vol. 41, part 1, 1932, pages 1-50. Total metallic production in Ontario for 1931 was $72,452,544, 13% less than 1930. Au production was $43,117,615, 20% more than in 1930. AHE (15a)

What Is Wrong with the Brass Foundry? William J. Reardon. *Metal Industry,* N. Y., Vol. 31, Jan. 1933, page 15. An article to the effect that the brass foundry must stop working at a loss. PRK (15a)

Materials for the Electrical Industry. L. H. Quin. *Electrical Review,* Vol. 112, Jan. 6, 1933, page 19. Reviews economic and market conditions relating to Cu, Sn, Pb, and Zn. MS (15a)

Rare Metal Developments in 1931. G. C. Riddell & Donald M. Liddell. *Mining & Metallurgy,* Vol. 13, Jan. 1932, pages 36-38. Comprehensive survey of a wide-ranging field that begins with cosmic ray, ends with uranium and covers much between. VSP (15a)

Variations in the Prices of Metals in the Last Twenty Years. John C. Bailar, Jr. *Journal of Chemical Education,* Vol. 10, Feb. 1933, pages 99-107. Iron and steel market follows economic development of country more closely than do other metals. Cu industry has had prosperous periods within last 2 decades. Most important factors in determining prices of Zn and Pb have been development of new use for these metals. 9 references. GTM 15a)

Platinum in Peridotite Massives of Gokcha (Armenia) A. G. Betekhtin. *Tzvetnuie Metallui,* No. 3, Mar. 1932, pages 392-406. (In Russian.) Preliminary explorations made with the object of ascertaining the occurrence of Pt in the Gokcha peridotite massive have not yielded any positive results. BND (15a)

Technical Advance On the Mesabi Iron Range. Russell H. Bennett. *Mining & Metallurgy,* Vol. 13, June 1932, pages 261-264. Survey demonstrates a satisfactory degree of technical progress achieved in the last 15 years. Advances have been made along the line of blasting, loading, hauling, and concentration. A radically new concentration process will be put into use in the near future. Different methods of treatment used are washing, crushing, screening, sintering and drying. Reclaiming of lean material is done by magnetic roasting. Cost of fuel for magnetic roasting may be reduced by use of natural gas instead of coal. VSP (15a)

Prospects of the Development of Non-Ferrous Metal Industry in Bashkiria (USSR). S. E. Pozin. *Tzvetnuie Metallui,* No. 4, Apr. 1932, pages 578-584. (In Russian). Considerable deposits of Cu-Zn-Pb ores justify further development of non-ferrous industry in this district. BND (15a)

Influence of Basic Process on Ore Reserves. A. Portevin. *Metal Progress,* Vol. 24, Aug. 1933, pages 48, 54. The necessity for considering the use of ore reserves at present not in use or considered of inferior value is discussed in the light of the early exhaustion of our presently considered desirable ore reserves. WLC (15a)

The Metal Year 1932 (Das Metalljahr 1932) A. Marcus. *Die Metallbörse,* Vol. 22, Dec. 31, 1932, pages 1677-1678; Vol. 23, Jan. 1, 1933, page 4; Jan. 11, 1933, pages 36-37; Jan. 18, 1933, page 68; Jan. 25, 1933, page 100; Feb. 1, 1933, pages 132-133. Under the main viewpoints of the last annual review (See *Metals & Alloys,* Vol. 4, Mar. 1933, page MA 80 L9) Marcus summarizes the developments on the world markets in regard to (1) Cu emphasizing the liquidation of the Copper Exporters Inc., tariff politics of the U.S.A., and its consequences, Russian competition, production, consumption, supply, (2) Pb stressing consumption in the U.S.A., world production as compared with 1931, tendency of prices, (3) Zn, and (4) Sn. EF (15a)

Tin in 1932—Advance Summary. C. W. Merrill. *United States Bureau of Mines, Mineral Market Reports,* No. M.M.S. 212, Aug. 8, 1932, 2 pages. The U. S. produced 0.4 ton Sn in 1932, all from South Dakota, a decrease of 3.3 tons from 1931. Production of secondary Sn was 13,170 tons; 17,679 tons in 1931. Imports were 34,819 tons, as compared with 66,064 tons in 1931. AHE (15a)

NEWS NOTES

Battelle Announcement

Clyde E. Williams

The Trustees of Battelle Memorial Institute, Columbus, Ohio, announce the appointment of Clyde E. Williams as Director of the Institute, and Dr. H. W. Gillett as chief technical adviser. Announcement of these appointments comes with the news of an expansion program at Battelle. A greater range of research and development work within the Institute has been planned and, in addition, many new projects of outside sponsorship recently have been accepted.

Both Dr. Gillett and Mr. Williams have been associated with the Institute since 1929, Dr. Gillett as director, sharing the administrative duties of the directorship with Mr. Williams as associate director, and at the same time serving as metallurgical supervisor of the Institute.

Dr. Gillett will now devote his entire time to the scientific side of the work where his technical knowledge and outstanding ability will be utilized to the fullest extent on the Institute's own projects and its sponsored projects for industry. In his new capacity Dr. Gillett will be at the head of a group of engineers who will bring to these projects the highest type of scientific knowledge in the Institute's chosen fields.

Through his wide experience and broad interests, Mr. Williams brings to the directorship of Battelle Memorial Institute unusual fitness and ability to direct the work of the Institute.

Blum and Reinartz added to Metals & Alloys Editorial Advisory Board

Two new members have been added to our Editorial Advisory Board: Dr. William Blum, Section Chief, U. S. Bureau of Standards and L. F. Reinartz, Works Manager, American Rolling Mill Company.

Revere Appoints Howell Pacific Coast Manager

A. J. Howell has been appointed manager of the Pacific Coast district of Revere Copper and Brass Incorporated to succeed R. H. Binns, Jr., who moves to the Executive Offices in New York City, as Assistant General Sales Manager. Mr. Howell has been with Revere on the Pacific Coast since the opening of an office there in 1932 and for many years previously represented the Rome Division of Revere on the coast. He will make his office in the Russ Building, San Francisco. Branch sales offices for this district are maintained in Los Angeles and Seattle.

New Distributors for ENDURO

Gate City Iron Works Co., Omaha, Nebr., and Earle M. Jorgensen Co., Los Angeles, Calif., are newly appointed distributors of ENDURO Stainless Steel, according to announcement by N. J. Clarke, Vice President in Charge of Sales, Republic Steel Corporation, Youngstown, Ohio.

Air Reduction Sales Company Distributors of SIL-FOS

The new low melting point brazing alloy, SIL-FOS, manufactured by Handy & Harman will hereafter be distributed by the Air Reduction Sales Company from all "Airco" Stations throughout the United States, in addition to many prominent supply houses.

The appointment of **H. S. Colby** as General Sales Manager of Combustion Engineering Company has just been announced by R. M. Gates, Vice President of that company. Mr. Colby, until recently, was President of the Air Preheater Corporation. His technical education was acquired at Cooper Union and Columbia University and for the past 20 years he has been engaged in the design, production and sales of steam generating equipment involving boilers, stokers, pulverizers, economizers and air preheaters.

Ingersoll Steel & Disc Co. Celebrates Golden Anniversary

The Ingersoll Steel & Disc Co., a division of the Borg-Warner Corporation, celebrated its 50th anniversary. The second generation of Ingersolls is now carrying on the business founded in 1884 by Stephen A. Ingersoll at Sandoval, Ill. R. C. Ingersoll, the eldest son of the founder of the company, is president of the Ingersoll Steel & Disc Company, and his two brothers, Harold G. Ingersoll and Stephen L. Ingersoll, are vice president and treasurer, and vice president, respectively, of the present organization. In 1884 a company was formed by Stephen A. Ingersoll known as the Sandoval Manufacturing Company for the production of agricultural implement discs. In a small shop in Sandoval, Ill., Mr. Ingersoll and 10 shop men started manufacturing coulter discs for plow shares and soon expanded their products to include discs for various agricultural and road machinery. In this work they achieved an enviable reputation as rollers and fabricators of high grade steels. The name of the company was subsequently changed to the Coulter Disc Company, and in 1904 the company moved to Galesburg and became the Galesburg-Coulter Disc Company.

This small organization pioneered in the development of two- and three-ply steels. With the development of the automobile the Galesburg-Coulter Disc Company found their processes ideally adapted to the production of clutch plates and other automotive products. The company subsequently purchased a rolling mill at Newcastle, Indiana and a larger mill at West Pullman, Ill.

In order to diversify its manufactured products the strong Borg-Warner Corporation brought the Galesburg-Coulter Disc Company into its growing family of subsidiary organizations in 1929. In 1930 the company became known as the Ingersoll Steel & Disc Company. Under the Borg-Warner Corporation, this company, which had not only pioneered but established a strong reputation as producers of laminated farm implement steels, was able to emphasize research and development work with the result that a few years ago they perfected their revolutionary stainless clad steel known as IngAclad—a material having a surface of stainless steel with a perfectly bonded foundation of mild steel, giving the advantages of solid stainless steel at greatly reduced cost.

Early in 1934 the Ingersoll Steel & Disc Company announced the opening of a country-wide sales and service organization with representation at Milwaukee, Duluth, St. Paul, Minneapolis, San Francisco, Los Angeles, New Orleans, Detroit, Cleveland, Philadelphia, New York City and Buenos Aires.

In 1933 Ingersoll purchased the American patent rights to produce the famous German Krupp design of steel beer barrels. They have also been active in equipping breweries with tanks and other equipment fabricated of stainless clad steel. Recent increased demand for the higher alcoholic content beer has stimulated business for the Ingersoll-Krupp steel beer barrels and clad steel tanks.

J. L. Gregg, formerly with the Battelle Memorial Institute is now Research Metallurgist, Development & Research Department, Bethlehem Steel Company, Bethlehem, Pa.

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MANUFACTURERS' LITERATURE

Note: (This department is conducted for the convenience of the readers of METALS & ALLOYS desiring to add to their files copies of current literature issued by manufacturers. Any items desired can be secured free by applying direct to the issuing firms or in those cases where a number of items are wanted applications may be sent direct to this office. A coupon is provided on which the numbers of the items required can be listed.)

Testing Machines

Collection of Bulletins brought together in substantial looseleaf binder. Complete descriptions with illustrations of machines for testing the physical properties of material, instruments for dynamic tests and measurements under operating conditions. Fatigue, dynamic, repeated stress and creep testing machines. Instruments for static tests and measurement of stress and strain. Engine-indicating equipment. Baldwin-Southwark Corporation, Philadelphia, Pa. (151)

Bellis Lavite

36 page brochure giving complete information about Bellis Lavite for heating, tempering and annealing. Physical characteristics, specifications and an interesting page of questions and answers. Illustrated. The Bellis Heat Treating Co., Branford, Conn. (152)

Electric Furnaces

Looseleaf binder with collection of bulletins dealing with electric furnace design, conveyor furnaces (floating belt type), box type electric furnaces, pot type electric furnaces, Carbonal process for carburizing steels, Hevi Duty "Atmosphere Control," Hevi Duty excess temperature cut-out, hot water at lowest cost, electric furnaces and hot plates for the laboratory. Illustrated. Charts. Cross sections. Specifications. Hevi Duty Electric Co., Milwaukee, Wis. (153)

Olympic Bronze

Brochure announcing a high copper alloy containing silicon and zinc designed especially for structural and engineering purposes. Tables, charts, photomicrographs, etc. This publication constitutes a hand book covering properties and uses of Olympic Bronze. Chase Brass & Copper Co., Incorporated, Waterbury, Conn. (154)

Hard Facing with Haynes Stellite Products

A 95 page book describing a group of materials particularly resistant to abrasive wear, and the hard facing process whereby these materials are effectively and economically applied to wearing surfaces to give them longer life. Illustrations from actual practice show a few of the almost numberless applications where the hard-facing process has saved money for industry. Haynes Stellite Company, Kokomo, Indiana. (155)

Enduro Type "S"

The Republic Steel Corporation has prepared a booklet describing this metal, and setting forth analysis of Enduro Type "S," average physical properties, applications, physical properties at high temperatures, instructions for working Enduro Type "S" and laboratory corrosion data. (156)

Chapmanizing

Bulletin describing process for hardening low carbon steel, what it is and what it does. Specifications and characteristics of Chapmanized metals. Wear tests. Illustrated. Chapman Valve Mfg. Co., Indiana Orchard, Mass. (157)

Forging Hammers

Bulletin, their number 220. Complete information for installation and operation, specifications, tables of dimensions for self-contained type and standard type. Many diagrams and illustrations. Erie Foundry Company, Erie, Pa. (158)

Lindberg Furnace Control

Data sheets announcing and describing the Lindberg Control for electric furnaces to regulate the rate of heating. Details of construction, directions for installing, applications and methods of operating. Lindberg Steel Treating Co., Chicago, Ill. (159)

Design for Profit

Interesting booklet showing what one metal "Zinc" can do. Brief exposition of the many profitable uses of zinc for a wide variety of products and services. Points out money making possibilities. Illustrated. New Jersey Zinc Co., 160 Front Street, New York, N. Y. (160)

Potentiometer Pyrometers

Catalog, their number 1101, describes line completely, reviewing more than 50 new and exclusive features. Circuit diagrams, operating diagrams, charts and many other illustrations. The Brown Instrument Co., Philadelphia, Pa. (161)

Hyro Automatic Furnace

Bulletin describing equipment for cyanide hardening and heat treating by other liquid bath processes. Specifications, phases of operation, special requirements. Illustrated. Parker-Kalon Corporation, 200 Varick St., New York, N. Y. (162)

Electric Heating Units and Devices

Hand book, 50 pages. Lists and describes G-W heating units of all types and for all uses. Tables, technical data, control equipment. Profusely illustrated. General Electric Company, Schenectady, N. Y. (163)

Furnaces

Collection of bulletins describing apron conveyor type, pusher type, box types, rotary hearth type, car type. Specifications. Illustrated. George J. Hagan Company, Pittsburgh, Pa. (164)

Industrial Application of the X-Ray

Bulletin, their number 284, revised. 36 pages. Complete treatise on the application of the X-Ray to industrial uses, including welding, die casting, sand casting, assemblies. Interpretation of Laue diffraction patterns. Notes on the selection of equipment. General Electric X-Ray Corporation, 2012 Jackson Boulevard, Chicago, Ill. (165)

Stainless Steel

Bulletin on Armco 18-8 and Armco 17. Helpful information about stainless steel sheets, plates, strip. Chemical analysis, mechanical properties, physical properties. Illustrated. American Rolling Mill Company, Middletown, Ohio. (166)

Heavy Duty Refractories

Compact hand book with all essential data. 60 pages. Complete descriptions, applications, tables and illustrations of standard shapes. Much useful engineering data. Norton Company, Worcester, Mass. (167)

Air Tools

Catalog, their number 2020, describes line of blowers, grinders, cutters, with all accessories. Portable compressors, diagrams, illustrated. Madison-Kipp Corporation, Madison, Wis. (168)

The Lewis Line (Rolling Mill Equipment)

Collection of bulletins in binder describing rolling mills for strip steel, merchant bars, sheet and tin plate, and for all non-ferrous metals. Shears-roll lathes, Neal patent reel for cold strip roll, special machinery. Completely illustrated. Lewis Foundry & Machine Co., 1512 Farmers Bank Building, Pittsburgh, Pa. (169)

Cut Heat Costs with "Vapofier"

Bulletin describing equipment applicable to 38 lines of business. Illustrated. Diagrams. Vapofier Corporation, 2807 So. Michigan Ave., Chicago, Ill. (170)

Amsco Alloy

Bulletin describing a line of nickel-chromium alloys for resisting heat, corrosion or acids. Available in six different analyses. Illustrated. American Manganese Steel Co., 6600 Ridge Avenue, St. Louis. Mo. (171)

Special Steels

A series of bulletins dealing with Union 1020-90, Union Hymo Steel, Union Special Finish, Union Precision Shafting, Union McQuaid-Ehn Steel, Union Free Cut Bessemer, Union Supercut Screw Steel, Union Special Carburizing Steel. Illustrated. Union Drawn Steel Co., Massillon, Ohio. (172)

Automatic Strainer

Bulletin describing equipment for continuously and automatically removing suspended solids from liquids. H. A. Brassert & Company, 310 So. Michigan Avenue, Chicago, Ill. (173)

Globe Wire Products

Bulletin describing high speed tool steels and stainless steels in bars, rods and wire. Firth-Sterling Steel Company, McKeesport, Pa. (174)

Rocking Electric Furnace

Type E-L. Bulletin describing this equipment for brass, iron and alloy steel. Detroit Electric Furnace Co., 825 West Elizabeth Street, Detroit, Mich. (175)

"Silcrome" Stainless Steels

Data sheet dealing with corrosion and heat resisting steels. Ludlum Steel Company, Watervliet, New York. (176)

(Published by the same firm. Bulletins on Seminole shock resisting tool steel, Saratoga Oil-hardening die steel, L-XX high speed steel, Dewart Oil hardening die steel and Ontario air hardening die steel.)

The Diamond Block Method of Hardening High Speed Steel

Bulletin describing the Sentry process. Complete data with instructions for the production man. The Sentry Company, Foxboro, Mass. (177)

The Firth "Winged" Ingot

Bulletin describing a new step in metallurgical progress used in the manufacture of tool steels. Illustrated. Technical data. Firth-Sterling Steel Company, McKeesport, Pa. (178)

Automatic Temperature Control for Blast Furnaces

Bulletin, their number 840, describes equipment indicated with charts and complete data. Leeds & Northrup Company, Philadelphia, Pa. (179)

Properties and Uses of Inconel

Bulletin, their number T-7, describes this alloy, gives properties, both mechanical and physical, data on corrosion, working properties, etc. Specific uses. Conclusions. International Nickel Co., 67 Wall St., New York, N. Y. (180)

(Published by the same firm, Bulletin, their number, T-8 on the welding of Inconel. Treats extensively of the subject indicated.)

The Homo Method Applied to Nitriding of Steel

Bulletin, their number 950, gives complete story of this method. Illustrations, complete diagram of Homo Nitriding Furnace. Leeds & Northrup Company, Philadelphia, Pa. (181)

"Trenite" Alloy

Data sheet giving information on Trenite, a cast alloy which resists heat, corrosion and wear. Applicable where a strong, tough, close-grained casting is desired for ready machinability and true finish. Contains also tensile strength chart. Trenite Corporation, Trenton, N. J. (182)

"Alumite" (Refractory)

Bulletin, their number 26, series A, describes Alumite Plast-O-Fractory, a mono-lithic or jointless furnace repair. Much interesting and valuable information. The Massillon Refractories Co., Massillon, Ohio. (183)

The Inside Story

Booklet describing Carboloy Service. Pertinent information regarding the company, its products and manufacturing facilities. Of interest to those desiring the greatest possible income in the operation of the machine shop. Carboloy Company, Inc., 4503 Hoff Avenue, Cleveland, Ohio (184)

Beryllium-Copper Castings — Foundry Practice, Heat Treatment, Properties

Publication of the American Foundrymen's Association written by Edwin F. Cone. Treatise on subject indicated. Tables of physical tests and properties. Applications. Beryllium Products Co., 420 Lexington Avenue, New York, N. Y. (185)

"Liquitol"

Bulletin, their number AL-16-A. Deals with the use of "Liquitol" for iron and steel castings and ingots. The Alpha-Lux Company, Inc., 192 Front Street, New York, N. Y. (186)

A Better Bond

Leaflet describing a high temperature refractory cement. Directions for use and advantages to be secured. Refractory & Engineering Corporation, 381 Fourth Avenue, New York, N. Y. (187)

Liquid Baths for Heat Treating

Hand book which discusses the operation of salt baths for tempering, normalizing, annealing and hardening of steel. Shows several different furnace designs and gives many pointers on the efficient operation of salt bath furnaces. E. F. Houghton & Co., 3rd & Somerset Streets, Philadelphia, Pa. (188)

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NEW EQUIPMENT and MATERIALS

Air-Operated Temperature and Pressure Controllers

Two new control instruments of practically identical appearance—Type 1119 for controlling temperature and Type 2119 for pressure—are announced by the Foxboro Company, Foxboro, Mass., and will be found particularly useful where dependable control at a definite control point must be provided inexpensively. The dial and knob on the lower face are for setting. The pressure gage indicates the air pressure on the diaphragm-motor of the control valve and thus shows whether the valve is opening or closing. On the temperature controller, a 2″ dial type thermometer may be installed in place of this air gage and connected to the same bulb as the controller, thus showing the temperature being maintained. The pressure controller may be equipped likewise with a high-pressure indicating gage that shows the pressure being controlled. In either case, it is necessary to mount a valve motor air gage on the air line to the valve outside the case. The universal case may be either flush or surface mounted. The connection may be top, bottom or back and the choice can be made on the job when the instrument is being set up which takes little time. All working parts are integral with or mounted on a cast aluminum base. By removing the setting knob set screw and two other screws, the entire case can be removed, leaving the interior open to inspection.

New Special Tempering Furnace

A Homo tempering furnace specialized for heavy, dense loads of small articles has recently been introduced by the Leeds & Northrup Company, Philadelphia, Pa. With this furnace, it is possible to dump a large load of dense work—small bolts, rivets or other small parts—into the work basket, without distributing them on trays, and yet secure that straight-line uniformity which is characteristic of Homo tempering. Production per hour is often multiplied as much as three or four times. Actual temperature-exploration charts have been made from practical heats carried out under actual production conditions. For one of these tests, eight thermocouples—pre-checked for uniformity—were distributed at various points throughout a load of 800 lbs. of ¼″x¾″ rivets, poured into a 25″x19″ work basket. The charts show clearly how the load comes up to temperature evenly, lines out exactly at the control point without overshooting, then remains rigidly at the holding temperature. Production of rivets was 960 lbs. per hour to uniformity; on 3″x⅜″ bolts, 1100 lbs. per hour to uniformity. These figures are conservative; many users will report considerably higher productions. In this specialized furnace, a newly designed fan is used. It is highly efficient and powerful—pulls prodigious amounts of heated air through dense work at terrific speed. Each part is heated alike—parts at the bottom are heated to the same temperature at the same rate as parts at the middle, top and sides. Other characteristics of Homo Furnaces are retained—such as automatic control and economy of operation.

New General-Purpose Welding Electrode

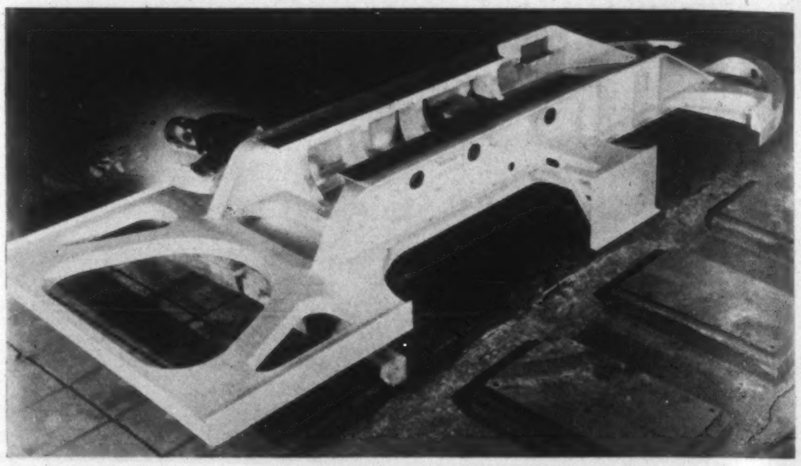
A general-purpose welding electrode, designated as the Type W-22, has been developed by the General Electric Company, Schenectady, N. Y. The new electrode is of the heavily coated or shielded-arc type and produces welds of the quality required for Class I pressure vessels according to the A.S.M.E. Boiler Construction Code. Its distinctive feature is that it may be used in any position, i. e., for flat, vertical, or overhead welding, and at the same time has deep penetrating properties. It is therefore equally suitable for butt and fillet welds. The W-22 electrode has a wide field of application in the fabrication of large structures, such as ships and locomotives, where it is impossible or impracticable to move the work into a special welding position—and in the welding of such fittings as nozzles and flanges to pressure vessels, where handling costs are less if positioning of the work is unnecessary.

General-Purpose Milling Cutter

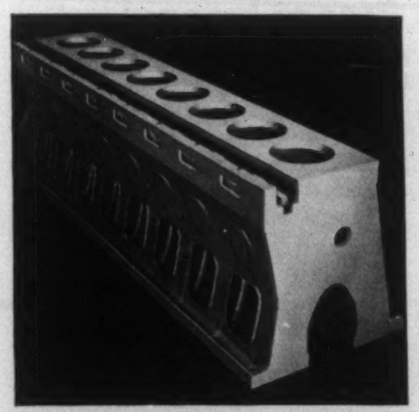
Carboloy Company, Inc., Detroit, announces the development of a general purpose Carboloy face-milling cutter for universal use on cast iron, non-ferrous and non-metallic materials. The cutter, 5″ in diameter, may be used over a wide range of cutting areas on these materials. Heretofore the economical use of Carboloy milling cutters has been confined mainly to large, quantity-production jobs. This new general-purpose cutter has been developed for economical use on short-run, diversified milling jobs as well, it being possible to use the Carboloy standard cutter interchangeably on various milling jobs in the same manner as a high speed steel cutter. The field of economical use of the general-purpose cutter is instead to be found on general milling work—short run, highly diversified milling on many different kinds of materials. To make the general-purpose cutter practical for this type of work, modified designs are employed to produce economical results without the sensational increases in speeds, etc., which are common to Carboloy milling on large, quantity-production jobs.

Welded Steel Engine Bed on C. B. & Q. High Speed Streamlined "Zephyr"

On the Chicago, Burlington & Quincy Railroad Company's new high speed streamlined passenger train, the "Zephyr," the engine bed is of welded construction, fabricated from Lukens Cromansil steel. This application is believed to be the first instance of the use of a welded steel engine bed on a motive power unit employed in main line railway service in America. The welded steel underframe supports a load of approximately 60,000 lbs., consisting of the 600 h.p., Winton full Diesel engine and generator which power the train, and the forward half of the power car. This 30-ton dead load imposes severe impact stresses on its supporting bed under the operating conditions encountered in service. The stresses are of a fatigue nature, since they are repeated many times per mile. Because of the infinite variety of types of load to which the structure is subjected in service, analysis of the loads is highly indeterminate. Rail joints, switches and crossovers cause vertical impact. Acceleration and deceleration result in horizontal stresses of variable extent. Movement around curves at speed produces lateral stresses. Combinations of the various forms of stress can occur simultaneously. The requirements of service are further complicated by the necessity of minimizing weight. Naturally, the working stresses are high. The design of the engine bed was developed by Lukenweld, Inc., division of Lukens Steel Company, Coatesville, Pa., in coöperation with the Edward G. Budd Manufacturing Company, builder of the "Zephyr," and the railroad company. In developing the design, particular attention was given to the elimination of rectilinear elements which would involve undesirable concentrations of stress. Angles, channels and "picture-frame" correlations were avoided because they would result in severe changes in contour which, in turn, would be incipient points of failure. The engine bed is 25′ 3½″ long, 8′ 8″ wide, and fabricated from 5/16″ plates. In addition to the engine bed, the crankcase of the Winton full Diesel engine powering the train is also of welded construction, fabricated by Lukenweld, Inc., from Lukens Cromansil steel. The engine is two-cycle, 600 hp., with eight cylinders in line, direct connected to the generator. The complete engine, without generator and auxiliaries, weighs about 22 pounds per horsepower, which low ratio of weight to horsepower is largely the result of efficient design and fabrication in welded steel construction.



Completing the bed which supports the power car on the high speed, streamlined passenger train, the "Zephyr" of the Chicago, Burlington & Quincy Railroad. So far as is known, this bed is the first welded steel engine bed ever used on a motive power unit in main line railway service in America.



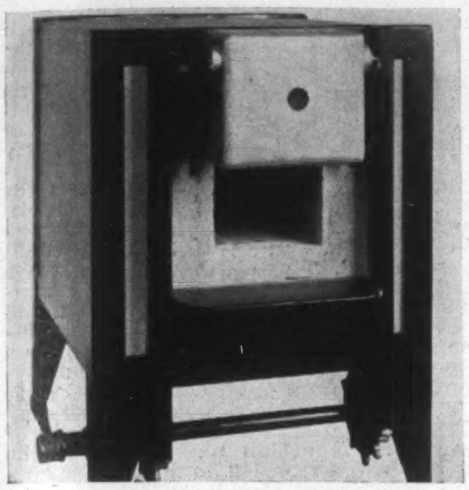
Crankcase of "Zephyr" fabricated by the arc welding method by Lukenweld, Inc.

Lunkenheimer Co. Executive Expires

Alfred J. Jupp, a Vice-President of the Lunkenheimer Company, Cincinnati, died suddenly in Roosevelt Hospital, New York, April 10, 1934, while on a business trip. Born in Cincinnati, June 25, 1875, Mr. Jupp entered the employ of the Lunkenheimer Co. in May, 1890. In 1896 he was made New York representative, returning to the home office in Cincinnati in 1913. Mr. Jupp was active in the Manufacturers' Standardization Society and also contributed the greater part of his time during recent months to code work in the Valve and Fittings Industry. Mr. Jupp was a member of the A.S.M.E., A.S.T.M., S.N.A.M.E. and in Cincinnati he belonged to the Engineers', Cincinnati, Queen City and Cuvier Press Clubs.

New Heat Element

The Doreco heating element of the Cooley Electric Furnace Company, Indianapolis, Ind., is essentially a nickel chromium resistor embedded within a solid block of a new refractory material called Semhet. Due to the high thermal conductivity of Semhet, the heat in the coil will be withdrawn and diffused rapidly; it also possesses high electric resistivity so that standard voltages may be applied without electrical leakage. The Doreco heating element is mechanically strong. It will withstand the strains of heating and cooling and shocks occurring in ordinary use of the furnace. Semhet has a compressive strength of 600 lbs./in.^{2} at 2500°F. and high resistance to internal heat stresses. It is hard, can be used as the furnace hearth without wear from abrasion and is not damaged from contact with ordinarily used materials. It is even highly resistant to iron oxide. The element is so designed that no ceramic muffles or plates are required for mounting in the furnace. At every point in the element, its heat is free to radiate without restriction, thereby eliminating damaging hot spots. In any element where the coils are compressed, particularly at the end turns, excess heat is developed at those points. Because in the Doreco element the Semhet is in intimate contact with the entire surface of the coil, localized heating is prevented, and the heat is drawn from the coil as it is developed. With no localized heat occurring, temperature distribution in the element is uniform to an unusual degree. The life of any element bears a definite relation to the rate of oxidation, but in this element, the dense almost impenetrable structure of Semhet protects the resistor and the life of the element is correspondingly increased. In chemical applications, this feature is particularly valuable as Semhet is practically impervious to fumes which would attack the resistor if exposed. Standard Doreco elements are designed for continued service at 1750° F. and intermittent service at 1850° F. For special application, Doreco elements are available for service at 200° F.



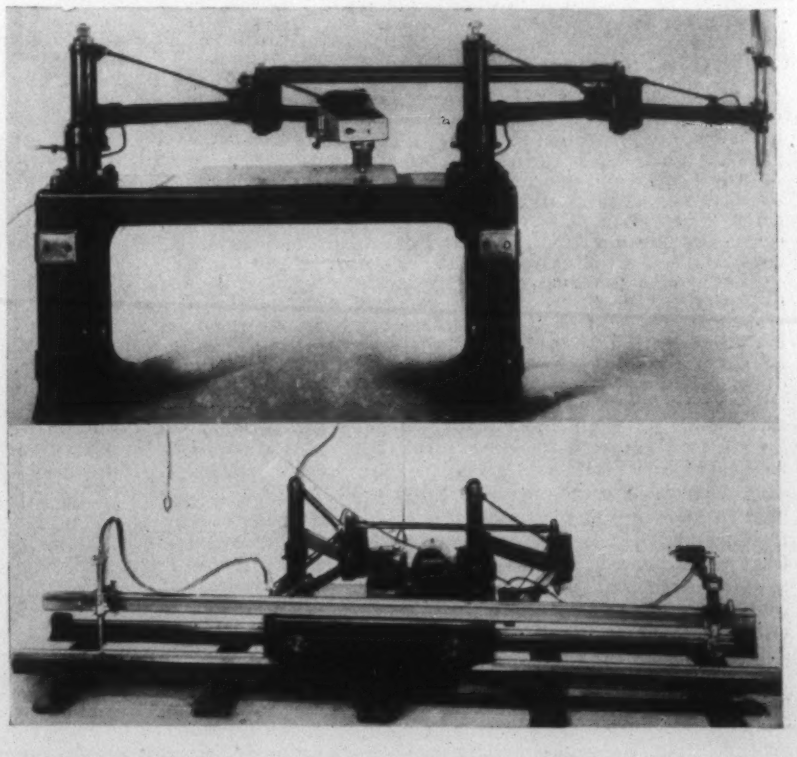
Improved Prepared Chrome Cement

Botfield Refractories Co., Philadelphia, Pa., has developed an improved chrome base refractory cement. The improved material is being marketed under the trade name of Adachrome super-cement and is said to be unique in that its component materials will not settle in the drum or mortar box but remain in suspension indefinitely. The base of this improved cement is high grade South African chrome ore with a high chromic oxide content and very low silica content. The grain sizes are prepared and graded accurately before the material is mixed; no change in grain sizes occurs in mixing since the commonly used "wet pan" is not employed in the manufacture of the cement. The cement is said to be extremely smooth and plastic, free from shortness, and workable even on refractory insulating brick which quickly absorb moisture from bonding mortars. It is also said to be most economical in amount required per thousand brick, and to be speedy in application. Adachrome super-cement is stated to develop a strong air set in a short time after application, without requiring heat. It does not contain silicate of soda. Its bond is attained by virtue of practically zero shrinkage, a crystalline structure and a non-silicate binder. Hence, the bond of the material is non-fluxing and non-glazing, even in the higher ranges of temperature, and is said to remain unusually strong even under load at high temperatures. Under test at the Mellon Institute of Industrial Research, Adachrome super-cement showed a pyrometric cone equivalent of cone 38, corresponding to a temperature of 3.335 degrees Fahrenheit. The ultimate fusion point or temperature at which the cement actually melts was not determined. At the highest temperatures, the cement showed no expansion. Because of its base of chrome ore, the cement is chemically neutral and therefore highly resistant to chemical reactions. It is said to be impervious to the attack of most slags, resistant to fusible coal ash and other fluxing ingredients in fuels, and to retard erosive and corrosive actions as well as prevent penetration of molten metal. Adachrome super-cement is usable in making dipped or trowled joints and in addition to laying up fire brick can also be employed for surfacing work. When mixed with Adachrome grog or similar material, it is adaptable for patching work or the making of furnace hearths or other monolithic refractory construction. The cement can be used with fire clay brick, high alumina brick, silica brick, chrome brick and magnesite brick in all types of boiler furnaces and industrial furnaces where temperatures are fairly high or where chemical reactions occur.

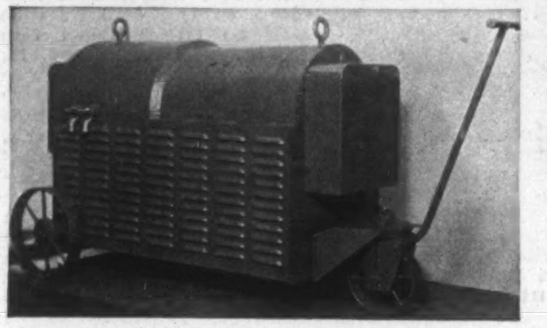
New Pantograph-Type Gas Cutting Machines

The Air Reduction Sales Company, New York, has added to its line of Pantograph-type gas cutting machines two new units, designated as the Airco-DB No. 7 Oxygraph and the Airco-DB No. 1 Travograph respectively, which greatly enlarge the range and scope of machine gas cutting. The basic principle of operation of these 2 machines is the same as that of the Airco-DB No. 6 Oxygraph, previously introduced. However, the No. 7 Oxygraph, employs a different pantograph construction, the fourth side of the parallelogram being removed to the rear. This arrangement allows the working ends of the arms to swing between the vertical posts which support the pantograph assembly, as well as in back of them, and permits the covering of a maximum cutting area with a given length of arms. No. 7 Oxygraph has no tracer bar, the tracer being attached to the end of one pantograph arm and the cutting torch to the end of the other arm. It is designed for single torch operation only. In this machine the tracing table for holding the full-scale drawing is part of the machine and is located on top of the bed between the vertical posts. Either a manually controlled or a magnetic tracer can be used with the No. 7 Oxygraph, each however requiring its respective adapter. The manually controlled tracer unit with its adapter is supplied as standard equipment. When using the magnetic tracer, cams are mounted overhead, attached to the substantial shank with nut located on top of each vertical post. In the case of the No. 1 Travograph, the pantograph assembly is mounted on a carrier that travels on rails. This feature accounts for its greatly extended cutting area as compared with the No. 6 Oxygraph in which the pantograph assembly is mounted on a heavy stationary base. Similar to the No. 6 Oxygraph the No. 1 Travograph is fitted with a long tracer bar, attached to the outer ends of the pantograph arms. The tracer mechanism and cutting torch holders are mounted on this bar and may be moved to any position along the bar and secured in place by set screws. As many as six cutting torches may be mounted on the bar for multiple cutting. The cutting torch or torches, being mounted on the same bar with the tracer, conform to the movement of the latter and cut a faithful reproduction of the path over which it travels. The No. 1 Travograph can also be operated with either manually controlled or magnetic tracer. The cams used with the magnetic tracer are mounted on the tracing table of this machine. In operating the No. 1 Travograph, the pantograph assembly is swung by hand to bring the tracer wheel and torch to the starting point of the cut, the tracer lowered until its full weight rests on the table, the torch adjusted to the proper height above the work and the driving motor started. The operator then guides the tracer along the lines of the drawing until the cut is completed. Automatic control of the carrier driving motor by the movement of the pantograph arms is a feature of the No. 1 Travograph. As these arms reach certain limiting positions in their swing in either direction, they operate switches which actuate the magnetic reversing starter of the carrier motor. In this way the carrier is automatically positioned to the most advantageous location at all times. The position of the tracing device, its speed and direction of travel automatically control the direction and extent of travel of the carrier.

The pantograph assembly on both the No. 7 Oxygraph and the No. 1 Travograph have arms of rugged proportions, adequately braced for maximum strength and rigidity under load. Hinge fittings likewise are amply proportioned. All bearing surfaces are of large area and accurately machined. The bearings which mount the assembly at the vertical posts, and all hinged joints, are equipped with large diameter ball bearings, designed for both thrust and radial loads. This assures smooth, almost frictionless operation. The No. 1 Travograph carrier is also precision built and has large wheels with ball bearing axles for smooth, easy running. The electrical circuit provides for giving the carrier driving motor a slow starting speed and smooth pick-up, thus eliminating any jarring of the tracer bar. At each end of the carrier base a limit switch opens the carrier motor circuit and brings the carrier to a gentle stop. The carrier drive can be disengaged by a clutch, which pemits quick positioning of the carrier along the track. The carrier is adequately counter-weighted to offset the leverage of the pantograph with arms fully extended, and safety hooks preclude any possibility of accidental tipping. The cutting area or range of the No. 7 Oxygraph is a 30 inch square or a 36 inch diameter circle, while that of the No. 1 Travograph is a rectangle 4½ feet in width and 11 feet in length with one 16 foot section, or any length desired with additional rail sections.

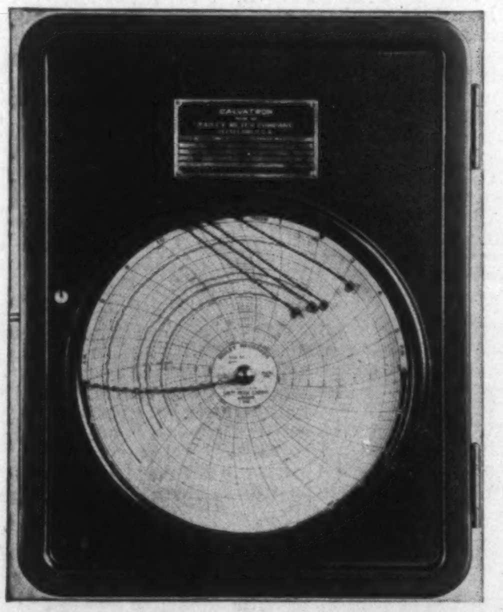


New 400 Ampere Welder



The Westinghouse Electric & Manufacturing Co., East Pittsburgh, Pa., has just recently developed a new 400 ampere direct current welder driven by a 25 hp., 230 volt, d.c. motor. This machine is of the unit frame construction incorporating all of the latest features. The polarity is easily reversed by simply turning a simple thumb switch. The machine was designed for either bare or coated electrode service. In working out this design, the heavy service required in steel mill and ship yard production has been kept in mind by the design engineers.

New Potentiometer Pyrometer

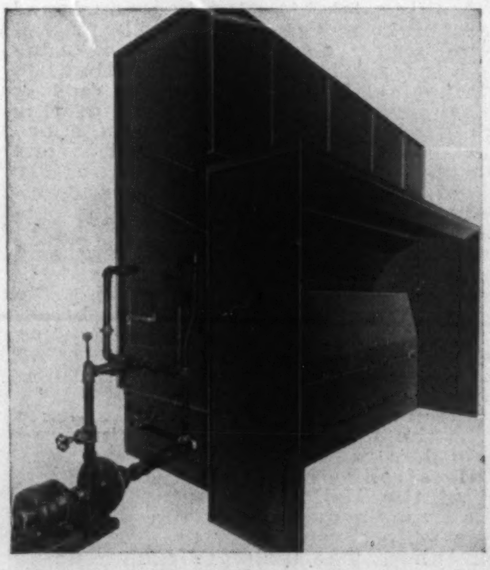


Bailey Meter Company, Cleveland, Ohio, has developed a new potentiometer pyrometer which has been named "Galvatron" as it employs a galvanometer-electronic relay circuit to operate slide wire resistances and recording pens. One Galvatron may include as many as 4 potentiometer circuits, the contact making galvanometer being automatically switched from one circuit to the next by relays actuated from contacts made by a synchronous motor-driven time device. One powerful synchronous motor drives these timing contacts for the relay as well as the galvanometer contacting mechanism, the recording chart, and the automatic standardizing relay contacts. The Galvatron mechanism consists of a galvanometer of short period arranged to make contacts of a duration proportional to the deflection of the galvanometer needle from neutral. These contacts which close the circuit to the electronic relay carry only a few micro-amperes of current, and are connected to the grids of Pliotron tubes. A galvanometer contact permits the flow of direct current through one Pliotron tube and the d.c. winding of its transformer whose second winding is in series with one field coil of a reversible synchronous motor driving the potentiometer unit. This flow of direct current permits a flow of alternating current through the transformer and field coil, thereby rotating the motor in one direction. Rotation in the opposite direction is produced in the same manner by energizing the other field coil through a second electronic relay when the galvanometer needle swings to the other side of neutral. Split second operation of the reversing synchronous motors is obtained by the use of the Galvatron circuit, since the electronic relays act instantaneously in accordance with the galvanometer contacts. Because of the very small current flow required to operate the electronic relay, it is possible to use light pressures on the galvanometer contacting mechanism without danger of burning. No failures to make contacts are experienced because of an increase in the resistance caused by collection of dirt or oxide at the contact points. A further advantage gained by the use of light contact pressure is the reduction of strain on the galvanometer needle and suspension ribbons. This permits the reduction of weight of the galvanometer needle thereby decreasing the operating period of the galvanometer and improving the speed of operation. Automatic standardization takes place approximately every 4 hours at which time the dry cell is balanced against a standard cell. Contacts from the galvanometer, properly amplified through the electronic relays, effect this balance by the adjustment of a motor driven resistance in series with the dry cell. A small indicator visible from the outside of the hinged panel on which the Galvatron mechanism is mounted shows the condition of the dry cell by a series of numbers, each successive number indicating that the dry cell is more nearly exhausted, until a red signal indicates that the cell should be replaced. In the case of a multi-pen Galvatron recorder, all records are continuous, although the contacts made by the galvanometer needle are divided among the potentiometers. In the case of a one-pen recorder, all contacts made by the galvanometer serve to adjust the potentiometer, which in this case is adjusted every four seconds if necessary. In the case of a four-pen recorder, each potentiometer receives a contact every 16 seconds, so that each record is a smooth continuous picture of existing conditions.

New Stripping Test for Udylite Coatings

The purpose of a stripping test developed by the Udylite Company, Detroit, Mich., is to determine the thickness of the applied coating and form a basis for thickness specifications. All tests which are now used and recommended are maximum thickness tests. They do not show the weak points of the plates and, therefore, do not give a definite indication of the value of the coating. Consequently, a minimum thickness test must be used. This new stripping test gives this minimum thickness accurately. It shows, also, the actual thickness at any one point. For this reason it points the way to improved plating practice where such is needed. Thus, if the stripping test shows small individual areas of thin plate on an area with otherwise heavier thickness, one can be absolutely sure that the cleaning can be improved upon. And if the recesses show a very thin plate in comparison with the protruding points, the plater knows at once that his racking arrangement is not what it should be, or that his solution is off. This test gives a great deal of very valuable information. The new stripping test is a decided improvement over some other such tests in several other respects. One very important thing is that its action is independent of the presence of amounts of impurities. Such impurities shorten the strip test time in other tests, and indicate a smaller thickness than that which is actually present. Another advantage is that the action of the new stripping test is independent of the nature of the base metal. The old test was always unreliable on cast iron. The method of testing is very simple. Two solutions are used, A and B. These are poured into 2 testing cups. The object to be tested is immersed in the cup containing A and kept there for 15 seconds. It is then rinsed in water and inspected. If the whole surface is covered with a brown film, the minimum thickness of the plate is at least .00005 inch. The film is now removed by rinsing in the cup containing B, rinsed in water and immersed for another 15 seconds in A. The inspection now shows if the minimum thickness is greater than .00010 inch. This procedure is repeated until the base metal stands out against the brown film on the plate, which is the end-point. If, for example, the end-point was reached after five 15 seconds' immersions, the minimum thickness of plate was at least 4 × .00005 = .0002 inch. If brass is the base metal it will not stand out very well against the brown film. It will, however, show plainly against the white plate after the object has been rinsed in dip B. The total time for each .00005 inch is about ½ minute and a .0002 inch plate is tested in about 2½ minutes.

New Water Spray Booth



The DeVilbiss Company, Toledo, Ohio, announces a new line of water booths. Water booths may be operated in neighborhoods where the use of standard fan or blower type booths would be prohibited. They are invaluable where the booth exhausts close to other buildings. Where vitreous materials are sprayed, this type of booth permits the control of objectionable dust and the reclamation of solids. Installation of these booths is simple. Exhaust piping is easily located to suit particular conditions. Height of stacks is reduced to a minimum and in some cases entirely eliminated. Maximum exhausting efficiency is assured by the elimination of accumulated paint on fan or within exhaust duct. Many outstanding and exclusive features are incorporated into these booths. "Opposed direction" sprays first directed with and then set against air flow to secure maximum efficiency of solids separation by sprays. Eliminator plates, equivalent to six 10° angles, remove free water from discharged air at low velocity. Watertight doors provide easy and convenient access to all sprays, strainer, overflow, valves and eliminator chamber. Units are sturdily built in every part and can be adapted to any type of spray booth.

High Tensile Strength Electrode

The Lincoln Electric Company, Cleveland, Ohio, announce a new electrode designed especially for use on high tensile steels. Here it provides welds with tensile strength of 85,000 to 100,000 lbs./in.^{2} and unusually high ductility. Ductility is from 15% to 20% elongation in 2 inches. "Shield Arc Eighty Five" is a heavily coated electrode of the shielded arc type. It is particularly suitable for the welding of those low alloy structural steels which, on normalizing, have tensile strengths under 100,000 lbs./in.^{2}—for example, Cromansil, low carbon nickel steels, structural silicon steels, low carbon manganese steels, Vanadium steels, and in general, all low alloy steels under .30% carbon.

"Shield Arc Eighty Five" is suitable for flat, vertical and overhead welding, and is available in 5/32" and 3/16" sizes. For most vertical and overhead welding the 5/32" size is preferred; however, for vertical welds in thick plate 3/16" may be used.